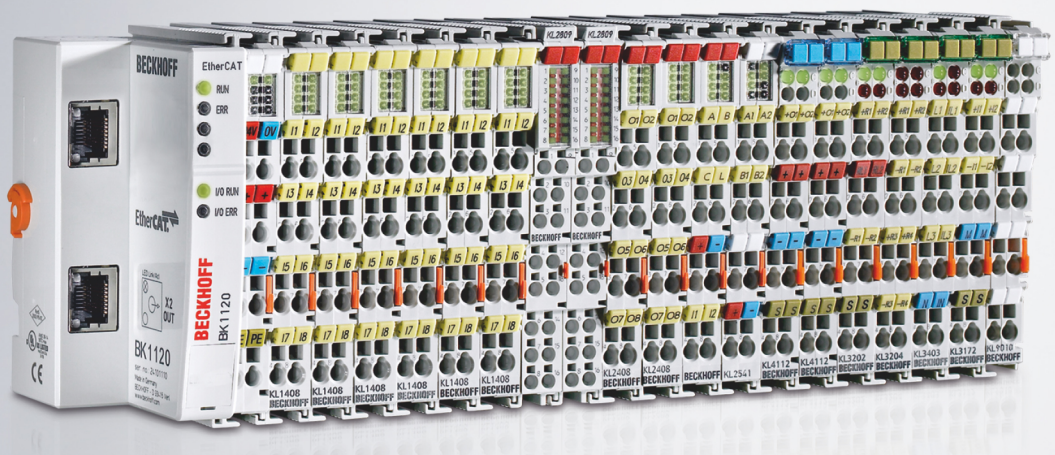
BECKHOFF New Automation Technology

Documentation | EN

KL2xxx and KS2xxx

Digital output terminals, 24 V DC



2023-08-16 | Version: 3.2.0

Table of contents

1 Foreword

1.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

Trademarks

Beckhoff®, TwinCAT®, TwinCAT/BSD®, TC/BSD®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, Safety over EtherCAT®, TwinSAFE®, XFC®, XTS® and XPlanar® are registered trademarks of and licensed by Beckhoff Automation GmbH. Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702 with corresponding applications or registrations in various other countries.

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Copyright

1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Signal words

The signal words used in the documentation are classified below. In order to prevent injury and damage to persons and property, read and follow the safety and warning notices.

Personal injury warnings

⚠ DANGER
Hazard with high risk of death or serious injury.

⚠ WARNING
Hazard with medium risk of death or serious injury.

⚠ CAUTION
There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE
The environment, equipment, or data may be damaged.

Information on handling the product

This information includes, for example:
recommendations for action, assistance or further information on the product.

1.3 Documentation issue status

Version	Comment
3.2.0	• KL2124/KS2124, KL2184/KS2184, KL2212/KS2212 and KL2284/KS2284 added • Technical data updated • Ex markings added to technical data • Chapter *Interference-free Bus Terminals* added • Chapter *Disposal* added • Chapter *Beckhoff Identification Code (BIC)* added
3.1.0	• Ex markings added to technical data • Instructions for ESD protection added • Chapter *ATEX - Special conditions (standard temperature range)* added • Chapter *IECEx - Special conditions* added • Chapter *cFMus - Special conditions* added
3.0.0	• Migration • Document structure updated • Technical data updated • Installation instructions for enhanced mechanical load capacity added • Revision status updated

Firmware and hardware versions

Documentation Version	KL2012, KS2012		KL2022, KS2022		KL2032, KS2032		KL2114, KS2114	
	Firmware	Hardware	Firmware	Hardware	Firmware	Hardware	Firmware	Hardware
3.2.0	-	05	-	09	-	05	-	05
3.1.0	-	05	-	09	-	05	-	05
3.0.0	-	05	-	09	-	05	-	05

Documentation Version	KL2134, KS2134		KL2124, KS2124		KL2184, KS2184		KL2212, KS2212		KL2284, KS2284	
	Firmware	Hardware	Firmware	Hardware	Firmware	Hardware	Firmware	Hardware	Firmware	Hardware
3.2.0	-	09	-	03	-	06	-	03	-	02
3.1.0	-	09	-	-	-	-	-	-	-	-
3.0.0	-	09	-	-	-	-	-	-	-	-

Documentation Version	KL2404, KS2404		KL2408, KS2408		KL2424, KS2424		KL2488, KS2488	
	Firmware	Hardware	Firmware	Hardware	Firmware	Hardware	Firmware	Hardware
3.2.0	-	06	-	07	-	05	-	03
3.1.0	-	06	-	07	-	05	-	03
3.0.0	-	06	-	07	-	05		03

The K-Bus firmware and hardware version (delivery state) are indicated by the serial number printed at the side of the terminal.

Syntax of the serial number

Structure of the serial number: WW YY FF HH

WW - week of production (calendar week)
YY - year of production
FF - K-bus firmware version
HH - hardware version

Example with serial number 49 05 1B 03:

49 - week of production 49
05 - year of production 2005
1B - firmware version 1B
03 - hardware version 03

1.4 Interference-free Bus Terminals

Use of interference-free Bus or EtherCAT Terminals in safety applications

If a Bus or EtherCAT Terminal is described as interference-free, this means that the consecutive terminal behaves passively in a safety application (e.g. in the case of the all-pole switch-off of a potential group).
In this case the terminals do not represent an active part of the safety controller and do not affect the Safety Integrity Level (SIL) or Performance Level (PL) attained in the safety application.
For details, please refer chapter “All-pole disconnection of a potential group with downstream interference-free standard terminals (Category 4, PL e)” and following in the TwinSAFE application manual.

NOTICE

Pay attention to the hardware version

Please pay attention to the information about the hardware version and non-reactivity of the respective Bus Terminal in the chapters "Technical Data" or "Firmware Compatibility"!
Only terminals with the appropriate hardware version may be used without the attained SIL/PL being affected!

The Bus or EtherCAT Terminals regarded as interference-free at the time of preparing this document are listed in the following tables together with their respective hardware versions.

Terminal name Bus Terminal	from hardware version
KL2408	05
KL2809	02
KL2134	09
KL2424	05
KL9110	07

Terminal name EL/ELX terminal	from hardware version
EL2004	15
EL2008	07
EL2014	00
EL2022	09
EL2024	06
EL2034	06
EL2044	01
EL2068	00
EL2809	01
EL2819	00
EL2828	00
EL2869	00
EL2872	01
EL2878-0005	00
EL9110	13
EL9184	00
EL9185	00
EL9186	00
EL9187	00
EL9410	16
ELX1052	00
ELX1054	00
ELX1058	00
ELX2002	00
ELX2008	00
ELX3152	00
ELX3181	00
ELX3202	00
ELX3204	00
ELX3252	00
ELX3312	00
ELX3314	00
ELX3351	00
ELX4181	00
ELX5151	00
ELX9560	03

External wiring

The following requirements are to be ensured *by the system manufacturer* and must be incorporated into the user documentation.

- **Protection class IP54**
  The terminals must be installed in IP54 control cabinets to ensure the necessary protection class IP54.
- **Power supply unit**
  The standard terminals must be supplied with 24 V by an SELV/PELV power supply unit with an output voltage limit U_{max} of 60 V in the event of a fault.
- **Prevention of feedback**
  Feedback can be prevented through different measures. These are described below. In addition to mandatory requirements there are also optional requirements, of which only one needs to be selected.
  - **No switching of loads with a separate power supply**
    Loads that have their own power supply must not be switched by standard terminals, since in this case feedback via the load cannot be ruled out.

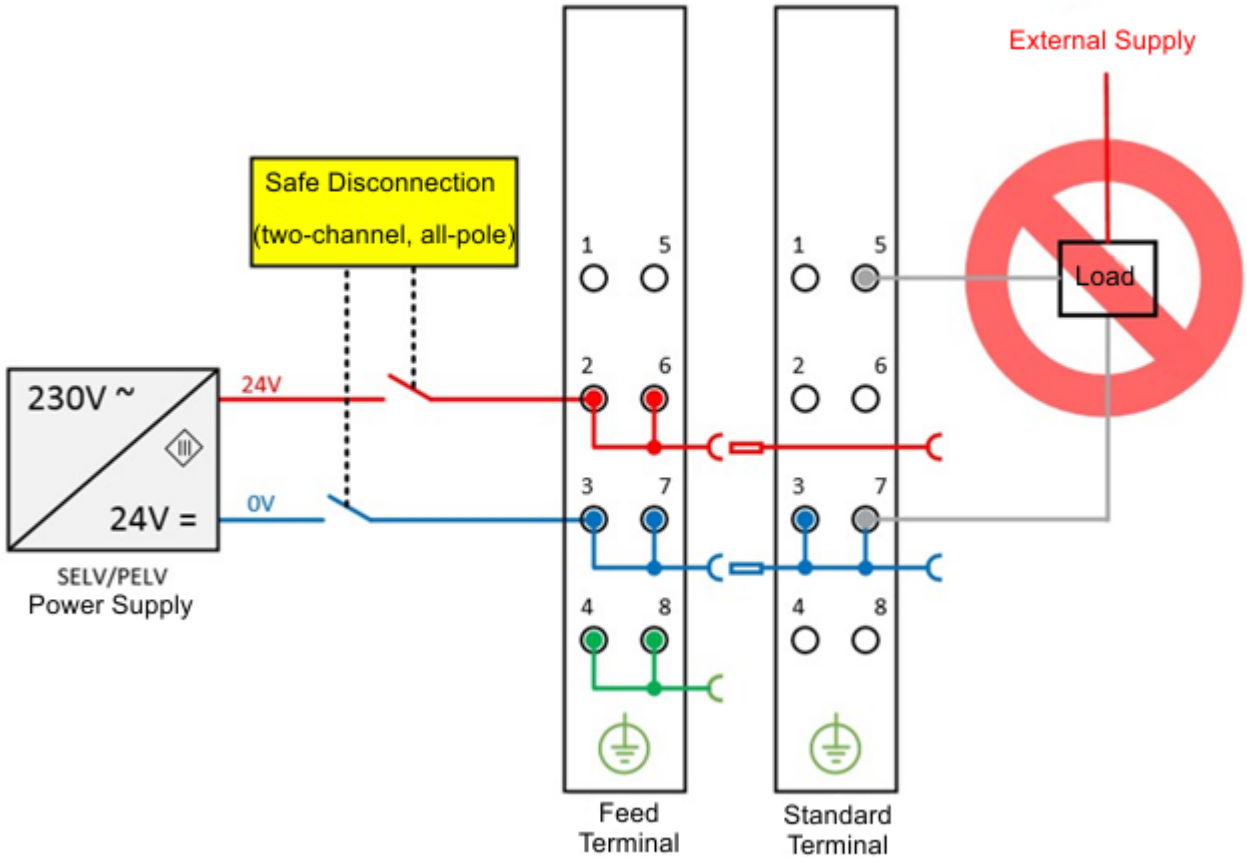


Fig. 1: Negative example – active load

- The control of an STO input of a frequency converter could serve here as a **negative example**. **Exceptions** to the general requirement are allowed only if the manufacturer of the connected load guarantees that feedback to the control input cannot occur. This can be achieved, for example, through adherence to load-specific standards.
- **Option 1: Ground feedback and all-pole disconnection**
  The ground connection of the connected load must be fed back to the safely switched ground.

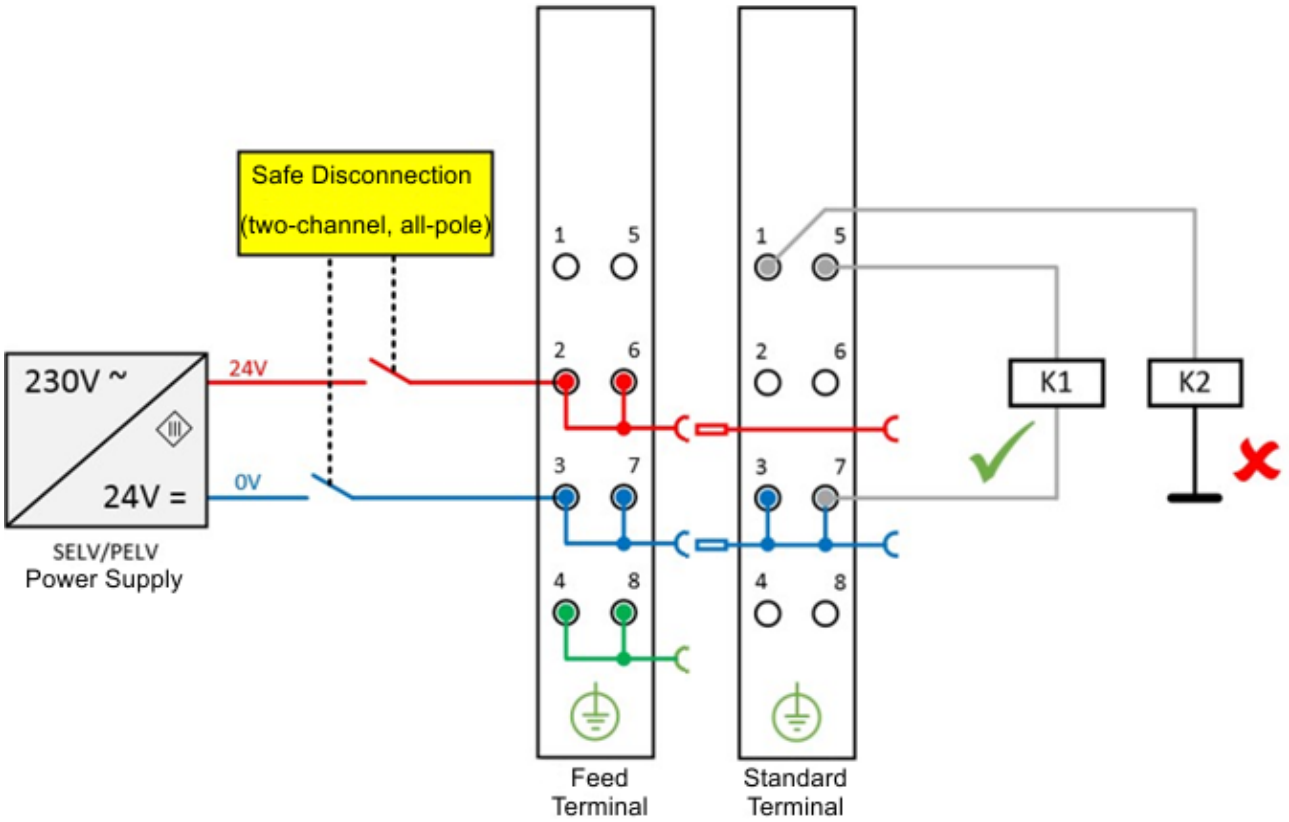


Fig. 2: Ground connection of the load: correct (K1) and incorrect (K2)

- If either
  a) the ground of the load is not fed back to the terminal or
  b) the ground is not safely switched but connected permanently

  then fault exclusions are necessary with regard to a short-circuit with external potential in order to be able to achieve Cat. 4 PLe according to EN ISO 13849-1:2007 or SIL3 according to IEC 61508:2010 (refer here to the overview in the chapter "Effect of options on the safety level").
- **Option 2: Cable short-circuit fault exclusion**
  If solution option 1 is not feasible, the ground feedback and all-pole disconnection can be dispensed with if the danger of feedback due to a cable short-circuit can be excluded by other measures. These measures, which can be implemented alternatively, are described in the following sections.

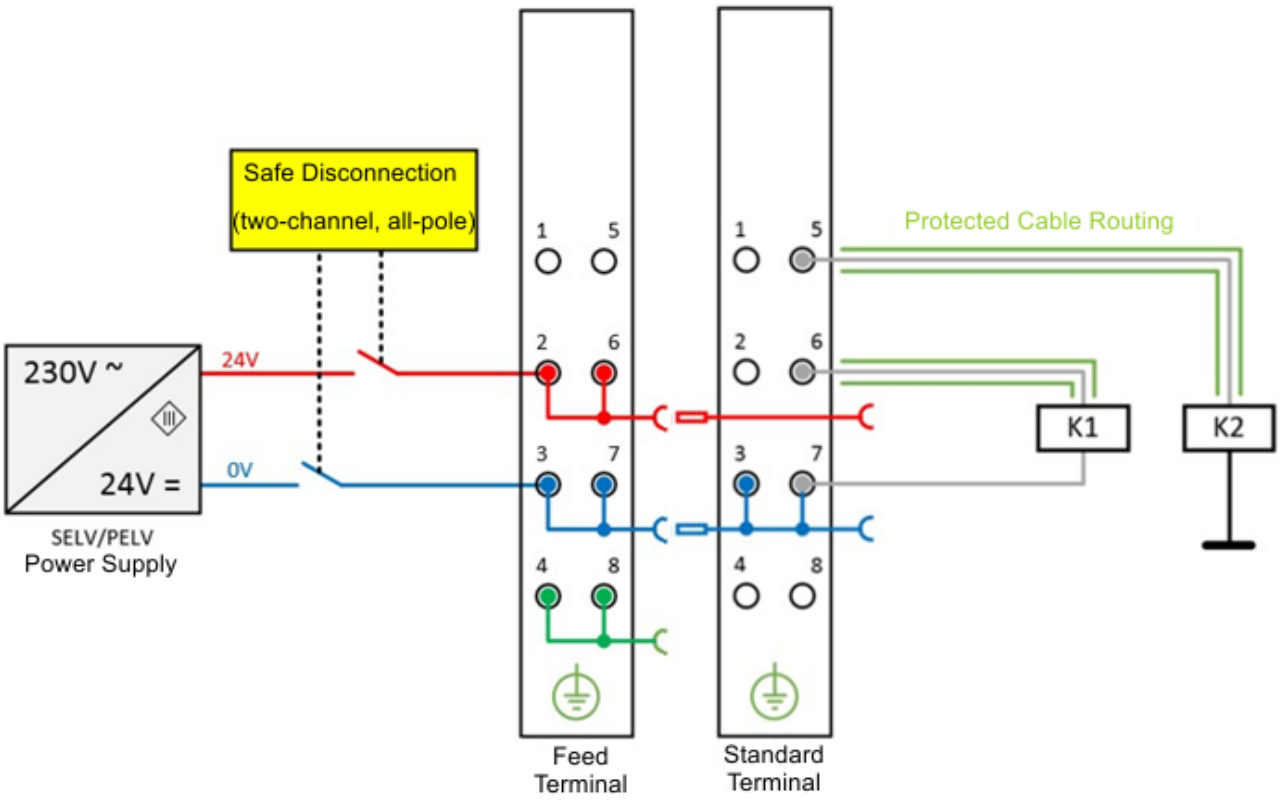


Fig. 3: Short circuit fault exclusion through protected cable laying

- **a) Possibility 1: Load connection via separate sheathed cables**
  The non-safely switched potential of the standard terminal may not be conducted together with other potential-conducting cores inside the same sheathed cable. *(Fault exclusion, see EN ISO 13849-2:2013, Table D.4)*
- **b) Possibility 2: Wiring only inside the control cabinet**
  All loads connected to the non-safe standard terminals must be located in the same control cabinet as the terminals. The cables are routed entirely inside the control cabinet. *(Fault exclusion, see EN ISO 13849-2:2013, Table D.4)*
- **c) Possibility 3: Dedicated earth connection per conductor**
  All conductors connected to the non-safe standard terminals are protected by their own earth connection. *(Fault exclusion, see EN ISO 13849-2:2013, Table D.4)*
- **d) Possibility 4: Cable permanently (fixed) installed and protected against external damage**
  All conductors connected to the non-safe standard terminals are permanently fixed and, e.g. protected against external damage by a cable duct or armored pipe.

- **Effect of the options on the safety level**
  In principle, standard terminals in safely switched potential groups are not an active part of the safety controller. Accordingly, **the safety level attained is defined only by the higher-level safety controller**, i.e. the standard terminals are not included in the calculation! However, the wiring of the standard terminals can lead to limitations in the maximum attainable safety level.
  Depending on the solution selected for the avoidance of feedback and the safety standard considered (see Option 1 and Option 2), different maximum attainable safety levels result, which are summarized in the following table:

Summary of safety classifications

Feedback avoidance measures	DIN EN ISO 13849-1	IEC 61508	EN 62061
Fault exclusion	max.	max. SIL3	max. SIL2 *
Cable short-circuit	Cat. 4		
Ground feedback and all-pole disconnection	PLe		max. SIL3

Note: All terminals in a potential group must be interference-free and it must be ensured that no energy is fed back by external circuitry, even in the event of a fault.

2 Product overview

Digital output terminals

Terminal	Number of outputs	Current	Comment
KL2012, KS2012 [▶ 14]	2	0.5 A	
KL2022, KS2022 [▶ 14]	2	2.0 A	
KL2032, KS2032 [▶ 14]	2	0.5 A	protected against reverse polarity connection
KL2114, KS2114 [▶ 20]	4	0.5 A	
KL2124, KS2124 [▶ 24]	4	20 mA	
KL2134, KS2134 [▶ 20]	4	0.5 A	protected against reverse polarity connection
KL2184, KS2184 [▶ 27]	4	0.5 A	ground switching
KL2212, KS2212 [▶ 30]	2	0.5 A	with diagnostics
KL2284, KS2284 [▶ 33]	4	2.0 A	for reverse switching
KL2404, KS2404 [▶ 36]	4	0.5 A	2-wire connection
KL2408, KS2408 [▶ 40]	8	0.5 A	1-wire connection
KL2424, KS2424 [▶ 36]	4	2.0 A	
KL2488, KS2488 [▶ 40]	8	0.5 A	ground switching

2.1 KL2012, KL2022, KL2032 - Introduction

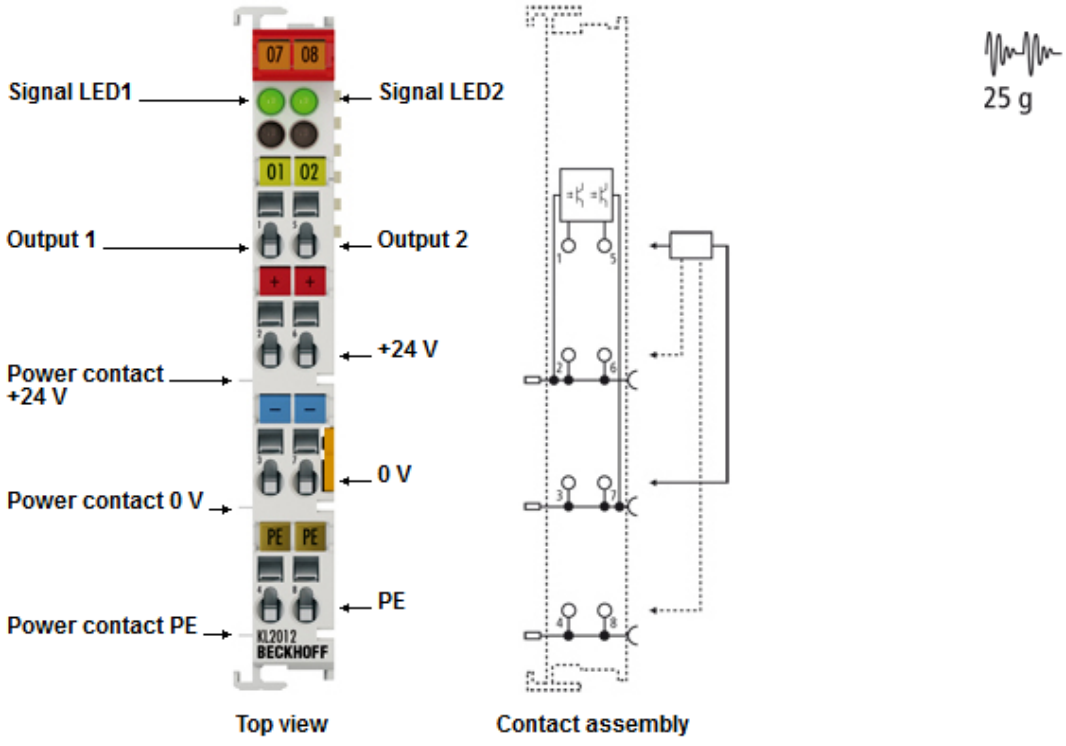


Fig. 4: KL2012 – 2-channel digital output terminal, 24 V_{DC}, 0.5 A

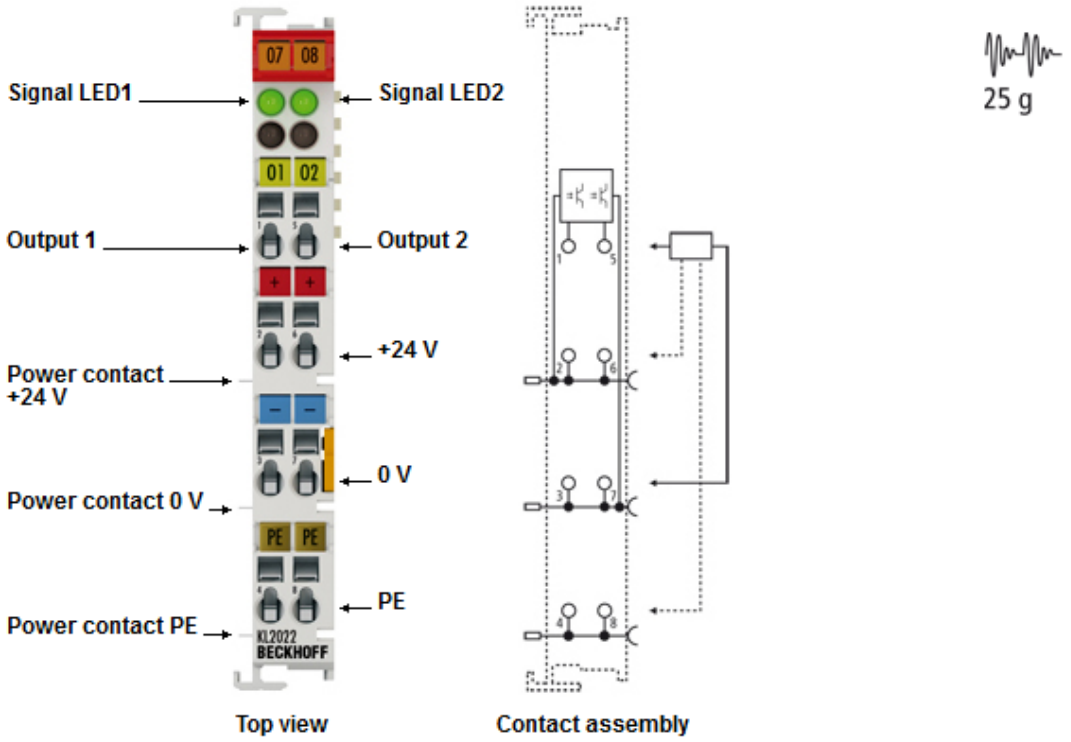


Fig. 5: KL2022 – 2-channel digital output terminal, 24 V_{DC}, 2 A

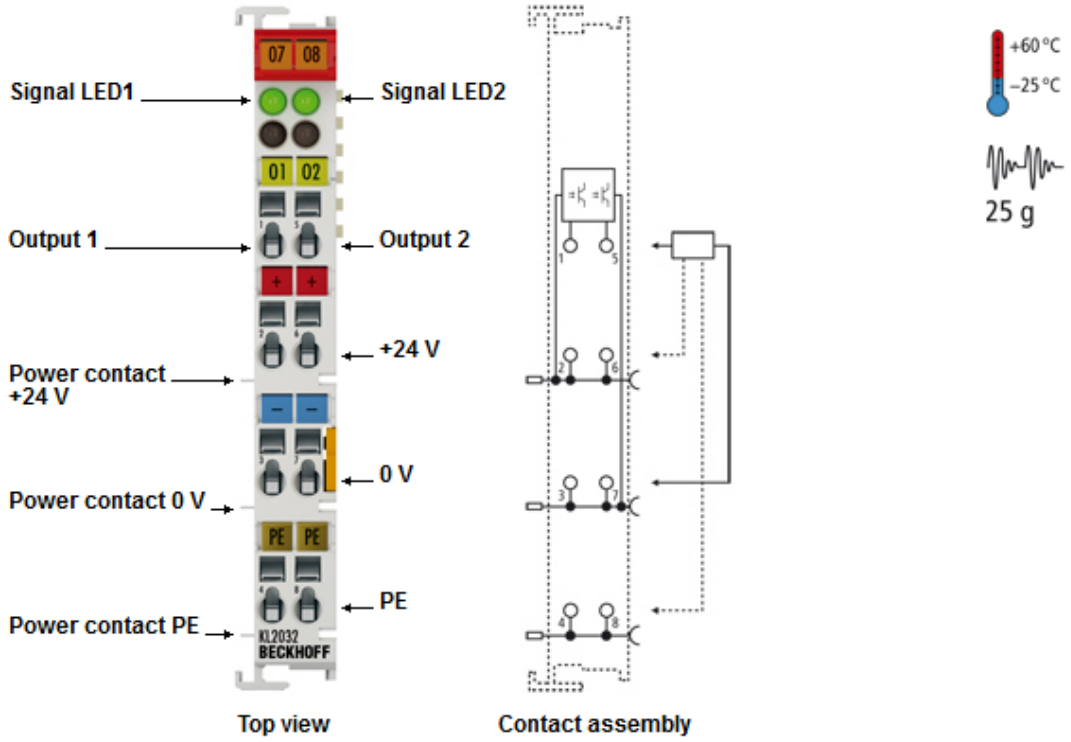


Fig. 6: KL2032 – 2-channel digital output terminal, 24 V_{DC}, 0.5 A, protected against reverse polarity connection

KL2012, KL2022, KL2032 – Bus Terminal, 2-channel digital output, 24 V_{DC}

The KL2012, KL2022 and KL2032 digital output terminals connect the binary control signals from the automation unit on to the actuators at the process level with electrical isolation. The KL2012 and KL2022 versions handle different load currents, and their outputs are protected against overload (only KL2012) and short circuit. The KL2032 Bus Terminal is protected against reverse polarity connection. The Bus Terminals contain two channels that indicate their signal state by means of light emitting diodes.

2.1.1 KL2012, KL2022, KL2032 - Technical data

Technical data	KL2012, KS2012	KL2022, KS2022	KL2032, KS2032
Connection technology	4 wire		
Number of outputs	2		
Nominal voltage	24 V_{DC} (-15 %/+20 %)		
Load type	ohmic, inductive, lamp load		
Max. output current (per channel)	0.5 A (short-circuit proof)	2.0 A (short-circuit proof)	0.5 A (short-circuit proof)
Max. short-circuit current	< 2 A	< 70 A	< 2 A
Breaking energy (ind.) max.	< 150 mJ/channel	< 1.7 J/channel	< 150 mJ/channel
Reverse polarity protection	no	no	yes
Electrical isolation	500 V (K-bus / field voltage)		
Current consumption via K-bus	typ. 5 mA		
Current consumption power contacts	typ. 15 mA + load	typ. 20 mA + load	typ. 20 mA + load
Bit width in process image	2 outputs		
Configuration	no address or configuration settings required		
Dimensions (W x H x D)	15 mm x 100 mm x 70 mm (width aligned 12 mm)		
Weight	approx. 55 g		
Mounting [▶ 45]	on 35 mm mounting rail conforms to EN 60715		
Permissible ambient temperature during operation	0°C ... +55°C		-25°C ... +60°C (extended temperature range)
Permissible ambient temperature during storage	-25°C ... +85°C		-40°C ... +85°C
Permissible relative humidity	95%, no condensation		
Enhanced mechanical load capacity	yes, refer also to Installation instructions for enhanced mechanical load capacity [▶ 48]		
Vibration / shock resistance	according to EN 60068-2-6 / EN 60068-2-27		
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4		
Installation position	variable		
Protection class	IP20		
Pluggable wiring	for all KSxxxx Bus Terminals		
Markings / Approvals*	CE, cULus, IECEx [▶ 55], ATEX [▶ 53]	CE, cULus, GL, IECEx [▶ 55], ATEX [▶ 53]	CE, cULus, GL, IECEx [▶ 55], ATEX [▶ 54]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

2.1.2 KL2012 - Contact assignment and LEDs

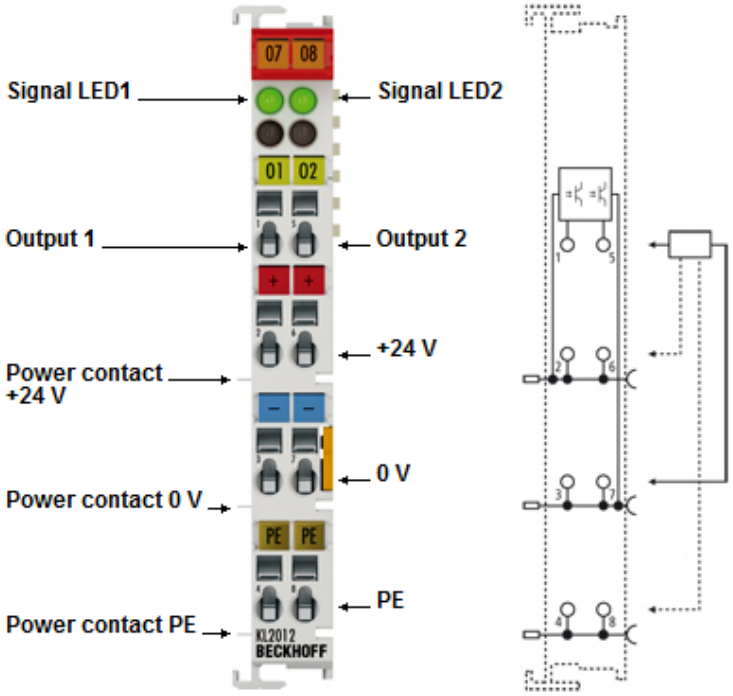


Fig. 7: KL2012 - Contact assignment and LEDs

KL2012 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
+24 V	2	+24 V (internally connected to terminal point 6 and positive power contact)
0 V	3	Ground for output 1 (internally connected to terminal point 7 and negative power contact)
PE	4	PE contact (internally connected to terminal point 8 and PE power contact)
Output 2	5	Output 2
+24 V	6	+24 V (internally connected to terminal point 2 and positive power contact)
0 V	7	Ground for output 2 (internally connected to terminal point 3 and negative power contact)
PE	8	PE contact (internally connected to terminal point 4 and PE power contact)

KL2012 - LEDs

LED	Color	Meaning	
Signal LEDs 1 - 2	green	off	Signal voltage "0"
		on	Signal voltage "1"

2.1.3 KL2022 - Contact assignment and LEDs

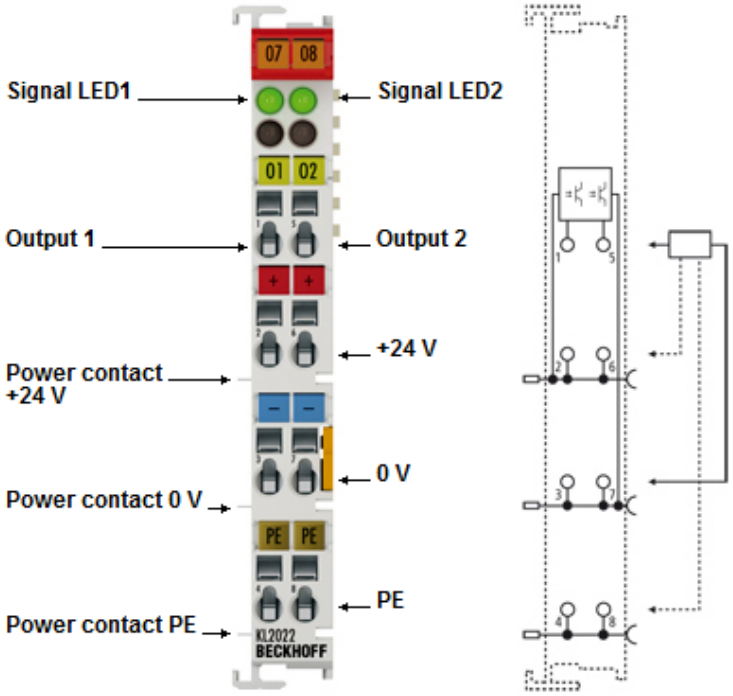


Fig. 8: KL2022 - Contact assignment and LEDs

KL2022 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
+24 V	2	+24 V (internally connected to terminal point 6 and positive power contact)
0 V	3	Ground for output 1 (internally connected to terminal point 7 and negative power contact)
PE	4	PE contact (internally connected to terminal point 8 and PE power contact)
Output 2	5	Output 2
+24 V	6	+24 V (internally connected to terminal point 2 and positive power contact)
0 V	7	Ground for output 2 (internally connected to terminal point 3 and negative power contact)
PE	8	PE contact (internally connected to terminal point 4 and PE power contact)

KL2022 - LEDs

LED	Color	Meaning	
Signal LEDs 1 - 2	green	off	Signal voltage "0"
		on	Signal voltage "1"

2.1.4 KL2032 - Contact assignment and LEDs

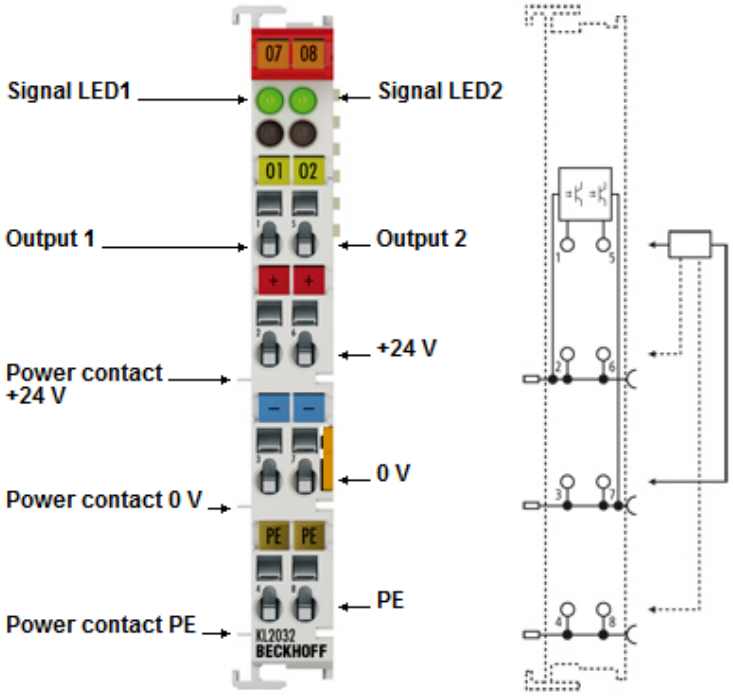


Fig. 9: KL2032 - Contact assignment and LEDs

KL2032 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
+24 V	2	+24 V (internally connected to terminal point 6 and positive power contact)
0 V	3	Ground for output 1 (internally connected to terminal point 7 and negative power contact)
PE	4	PE contact (internally connected to terminal point 8 and PE power contact)
Output 2	5	Output 2
+24 V	6	+24 V (internally connected to terminal point 2 and positive power contact)
0 V	7	Ground for output 2 (internally connected to terminal point 3 and negative power contact)
PE	8	PE contact (internally connected to terminal point 4 and PE power contact)

KL2032 - LEDs

LED	Color	Meaning	
Signal LEDs 1 - 2	green	off	Signal voltage "0"
		on	Signal voltage "1"

2.2 KL2114, KL2134 - Introduction

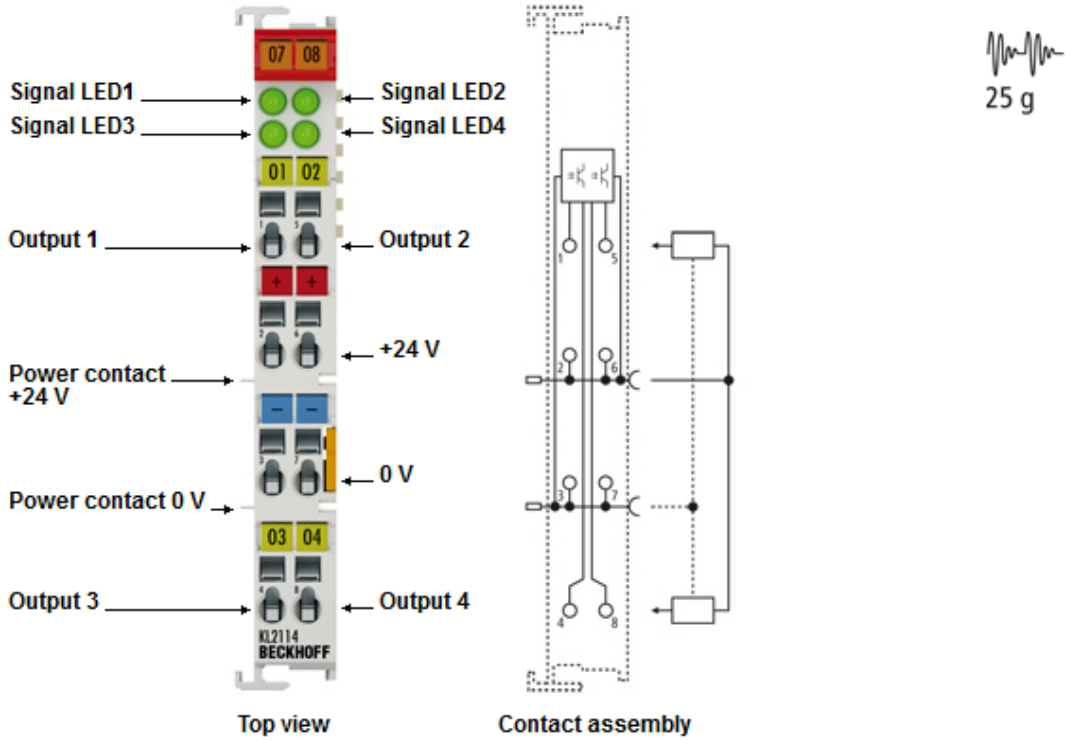


Fig. 10: KL2114 – 4-channel digital output terminal, 24 V_{DC}, 0.5 A

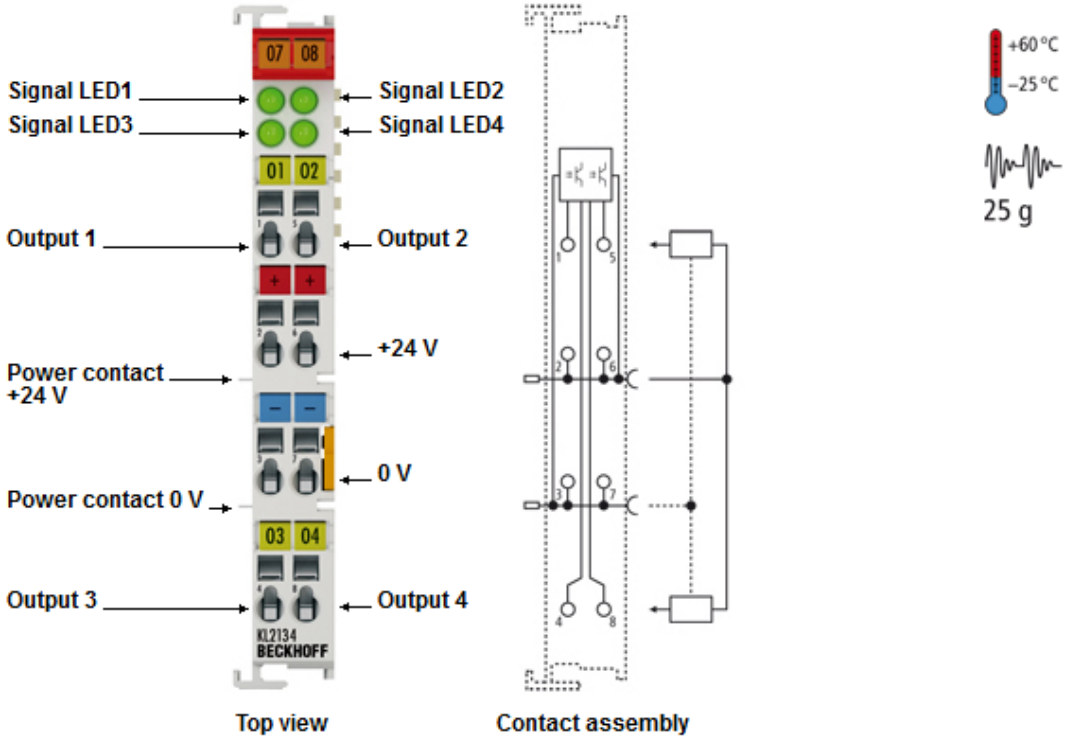


Fig. 11: KL2134 – 4-channel digital output terminal, 24 V_{DC}, 0.5 A, protected against reverse polarity connection

KL2114, KL2134 – Bus Terminal, 4-channel digital output, 24 V_{DC}

The KL2114 and KL2134 digital output terminals connect the binary control signals from the automation unit on to the actuators at the process level with electrical isolation. The load current output of the KL2114 version is protected against overload and short circuit. The KL2134 Bus Terminal is protected against reverse polarity connection. The Bus Terminals contain four channels that indicate their signal state by means of light emitting diodes.

2.2.1 KL2114, KL2134 - Technical data

Technical data	KL2114, KS2114	KL2134, KS2134
Connection technology	2-wire / 3-wire	
Number of outputs	4	
Nominal voltage	24 V_{DC} (-15 %/+20 %)	
Load type	ohmic, inductive, lamp load	
Max. output current	0.5 A (short-circuit proof) per channel	
Short circuit current	< 2 A	
Breaking energy (ind.) max.	< 150 mJ/channel	
Reverse polarity protection	-	yes
Electrical isolation	500 V (K-bus / field voltage)	
Current consumption power contacts	typ. 30 mA + load	
K-Bus current consumption	typ. 9 mA	
Bit width in process image	4 outputs	
Configuration	no address or configuration settings required	
Dimensions (W x H x D)	15 mm x 100 mm x 70 mm (width aligned 12 mm)	
Weight	approx. 70 g	
Mounting [▶ 45]	on 35 mm mounting rail conforms to EN 60715	
Permissible ambient temperature during operation	0°C ... +55°C	-25°C ... +60°C (extended temperature range)
Permissible ambient temperature during storage	-25°C ... +85°C	-40°C ... +85°C
Permissible relative humidity	95%, no condensation	
Enhanced mechanical load capacity	yes, refer also to Installation instructions for enhanced mechanical load capacity [▶ 48]	
Vibration / shock resistance	according to EN 60068-2-6 / EN 60068-2-27	
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4	
Installation position	variable	
Protection class	IP20	
Pluggable wiring	for all KSxxxx Bus Terminals	
Markings / Approvals*	CE, cULus, IECEx [▶ 55], ATEX [▶ 53]	CE, cULus, GL, IECEx [▶ 55], ATEX [▶ 54]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

2.2.2 KL2114 - Contact assignment and LEDs

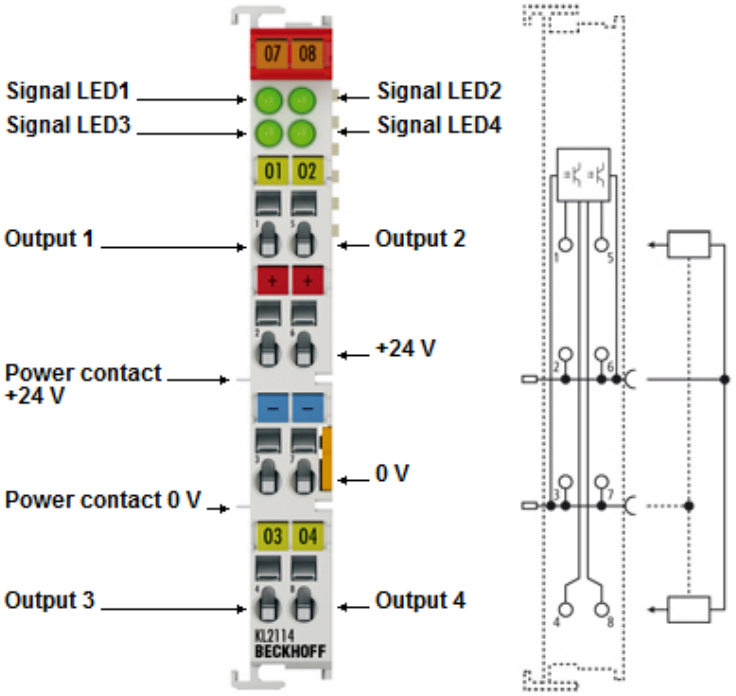


Fig. 12: KL2114 - Contact assignment and LEDs

KL2114 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
+24 V	2	+24 V (internally connected to terminal point 6 and positive power contact)
0 V	3	0 V (internally connected to terminal point 7 and negative power contact)
Output 3	4	Output 3
Output 2	5	Output 2
+24 V	6	+24 V (internally connected to terminal point 2 and positive power contact)
0 V	7	0 V (internally connected to terminal point 3 and negative power contact)
Output 4	8	Output 4

KL2114 – LEDs

LED	Color	Meaning	
Signal LEDs 1 - 4	green	off	Signal voltage "0"
		on	Signal voltage "1"

2.2.3 KL2134 - Contact assignment and LEDs

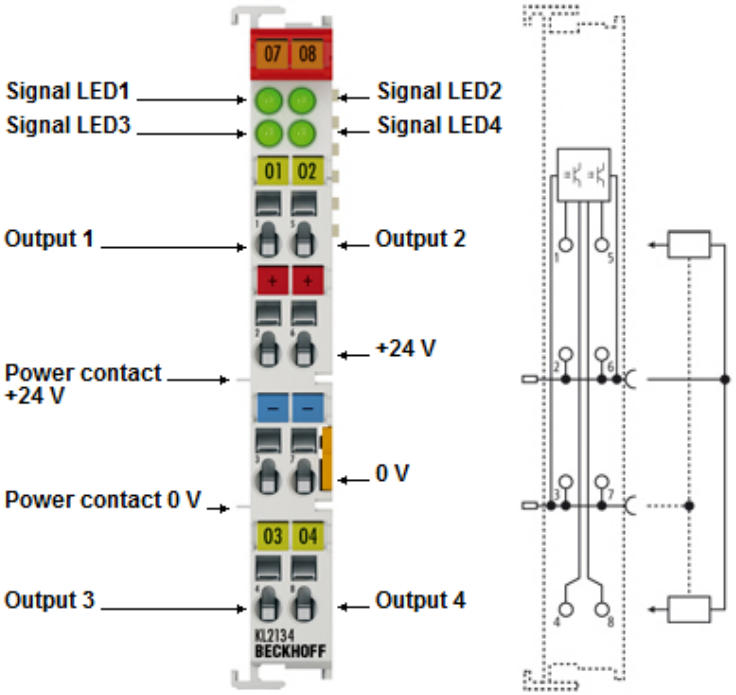


Fig. 13: KL2134 - Contact assignment and LEDs

KL2134 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
+24 V	2	+24 V (internally connected to terminal point 6 and positive power contact)
0 V	3	0 V (internally connected to terminal point 7 and negative power contact)
Output 3	4	Output 3
Output 2	5	Output 2
+24 V	6	+24 V (internally connected to terminal point 2 and positive power contact)
0 V	7	0 V (internally connected to terminal point 3 and negative power contact)
Output 4	8	Output 4

KL2134 - LEDs

LED	Color	Meaning	
Signal LEDs 1 - 4	green	off	Signal voltage "0"
		on	Signal voltage "1"

2.3 KL2124 - Introduction

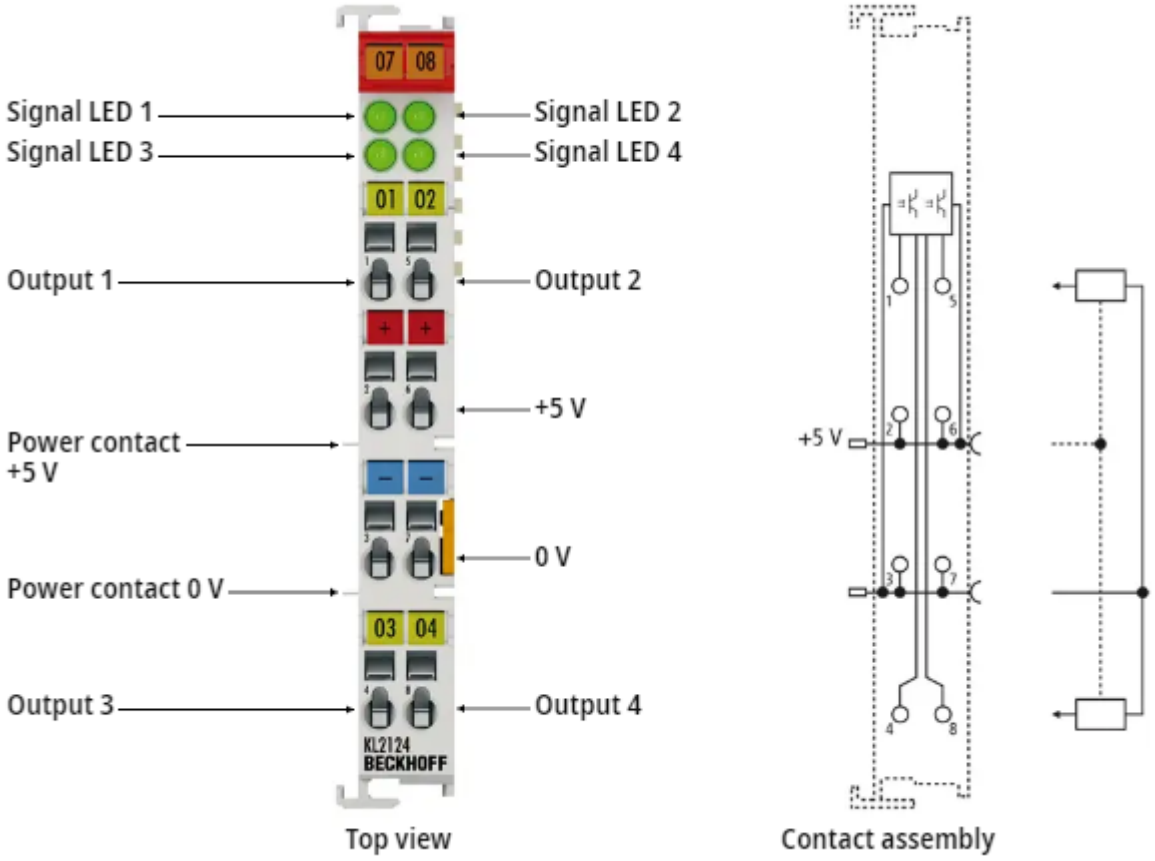


Fig. 14: KL2124 - 4-channel digital output

KL2124 - Bus Terminal, 4-channel, digital output terminal, 5 V_{DC}

The KL2124 digital output terminal connects the binary control signals from the automation unit on to the actuators at the process level with electrical isolation. The load current outputs of the KL2124 version are protected against overload and short circuit. The Bus Terminal contains four channels that indicate their signal state by means of light emitting diodes.

2.3.1 KL2124 - Technical data

Technical data	KL2124, KS2124
Connection technology	2-wire / 3-wire
Number of outputs	4
Nominal voltage	5 V_{DC}
Load type	ohmic, inductive, lamp load
Max. output current	±20 mA (short-circuit proof) per channel, 8 mA signal current
Short circuit current	-
Breaking energy (ind.) max.	-
Reverse polarity protection	yes
Electrical isolation	500 V (K-bus / field voltage)
Current consumption power contacts	typ. 16 mA + load
K-Bus current consumption	typ. 14 mA
Bit width in process image	4 outputs
Configuration	no address or configuration settings required
Dimensions (W x H x D)	15 mm x 100 mm x 68 mm (width aligned 12 mm)
Weight	approx. 70 g
Mounting [▶ 45]	on 35 mm mounting rail conforms to EN 60715
Permissible ambient temperature during operation	0°C … +55°C
Permissible ambient temperature during storage	-25°C … +85°C
Permissible relative humidity	95%, no condensation
Enhanced mechanical load capacity	yes, refer also to Installation instructions for enhanced mechanical load capacity [▶ 48]
Vibration / shock resistance	according to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Installation position	variable
Protection class	IP20
Pluggable wiring	for all KSxxxx Bus Terminals
Markings / Approvals*	CE, cULus, ATEX [▶ 53], IECEx [▶ 55]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

2.3.2 KL2124 - Contact assignment and LEDs

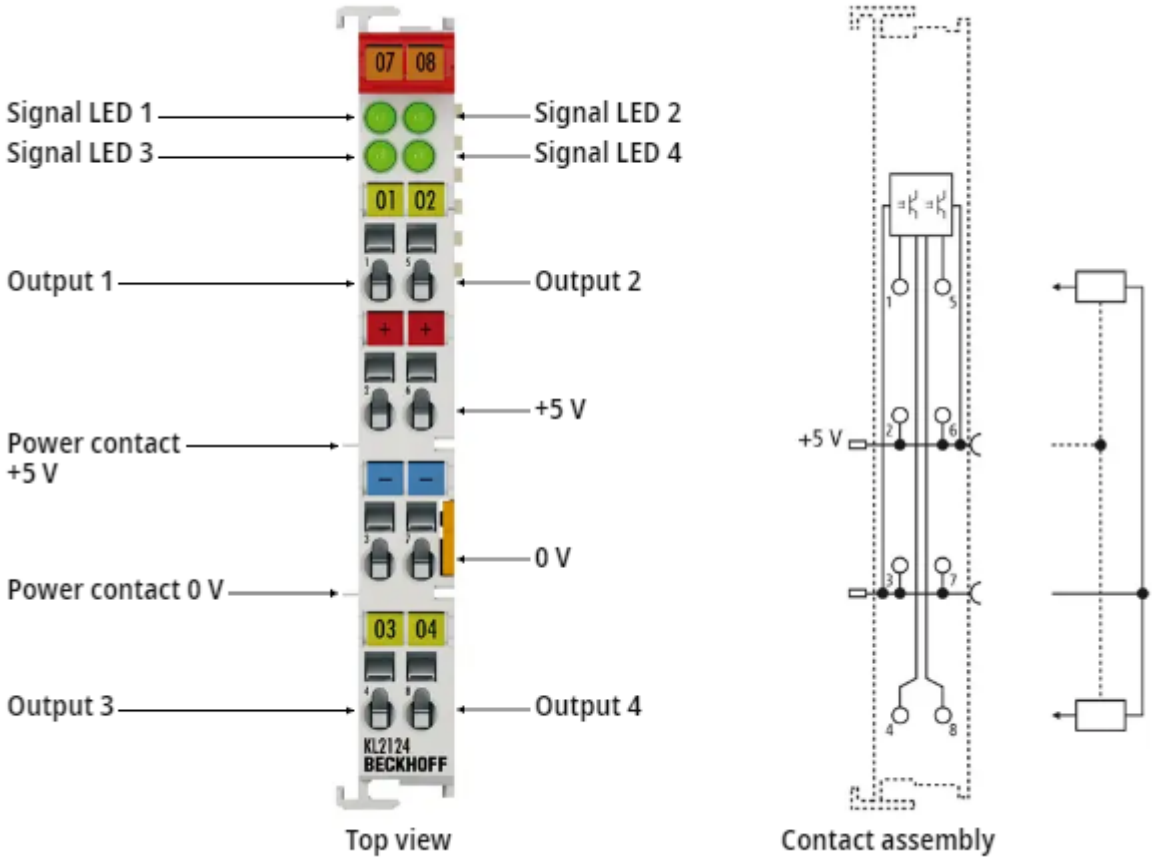


Fig. 15: KL2124 - LEDs and contact assignment

KL2124 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
+5 V	2	+5 V (internally connected to terminal point 6 and positive power contact)
0 V	3	0 V (internally connected to terminal point 7 and negative power contact)
Output 3	4	Output 3
Output 2	5	Output 2
+5 V	6	+5 V (internally connected to terminal point 2 and positive power contact)
0 V	7	0 V (internally connected to terminal point 3 and negative power contact)
Output 4	8	Output 4

KL2124 - LEDs

LED	Color	Meaning	
Signal LEDs 1 - 4	green	off	Signal voltage "0"
		on	Signal voltage "1"

2.4 KL2184 - Introduction

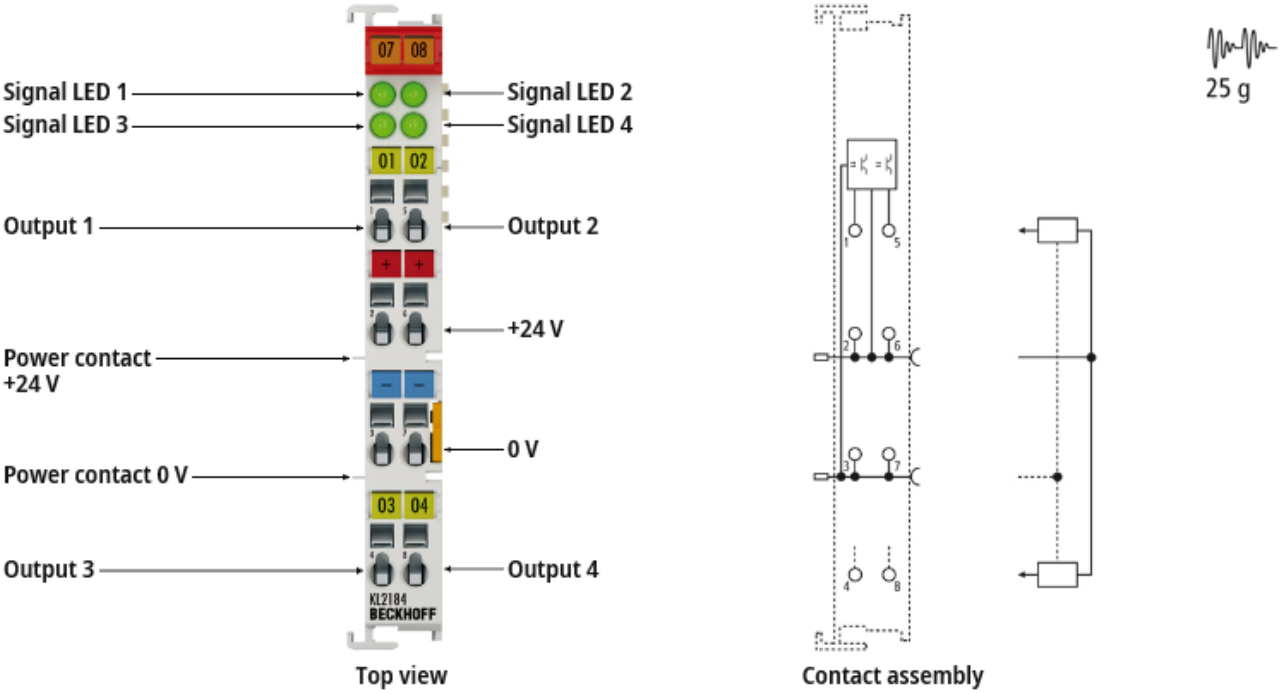


Fig. 16: KL2184 - 4-channel digital output terminal, 24 V_{DC}, 0.5 A, ground switching

KL2184 – Bus Terminal, 4-channel digital output, 24 V_{DC}, 0.5 A, ground switching

The KL2184 digital output terminal connects the binary control signals from the automation unit on to the actuators at the process level with electrical isolation. It has four ground switching outputs and generates load currents with outputs that are resistant to overload and short-circuit. The Bus Terminal contains four channels that indicate their signal state by means of light emitting diodes.

2.4.1 KL2184 - Technical data

Technical data	KL2184, KS2184
Connection technology	2-/3-wire
Number of outputs	4
Nominal voltage	24 V_{DC} (-15 %/+20 %)
Load type	ohmic, inductive, lamp load
Output current max.	0.5 A (short-circuit proof) per channel
Short-circuit current	< 7 A
Breaking energy (ind.) max.	100 mJ/channel
Reverse voltage protection	yes
Electrical isolation	500 V (K-bus/field potential)
Current consumption power contacts	typ. 30 mA + load
Current consumption K-bus	typ. 9 mA
Bit width in the process image	4 outputs
Configuration	no address or configuration setting
Dimensions (W x H x D)	15 mm x 100 mm x 70 mm (width aligned 12 mm)
Weight	app. 70 g
Mounting [▶ 45]	on 35 mm mounting rail conforms to EN 60715
Permissible ambient temperature during operation	0 °C … +55 °C
Permissible ambient temperature during storage	-25 … +85 °C
Permissible relative humidity	95 %, no condensation
Enhanced mechanical load capacity	yes, refer also to Installation instructions for enhanced mechanical load capacity [▶ 48]
Vibration/shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protect. class	IP20
Installation position	variable
Pluggable wiring	for all KSxxxx Bus Terminals
Approvals/markings*	CE, UKCA, UL, EAC, IECEx [▶ 55], ATEX [▶ 53]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

2.4.2 KL2184 - Contact assignment and LEDs

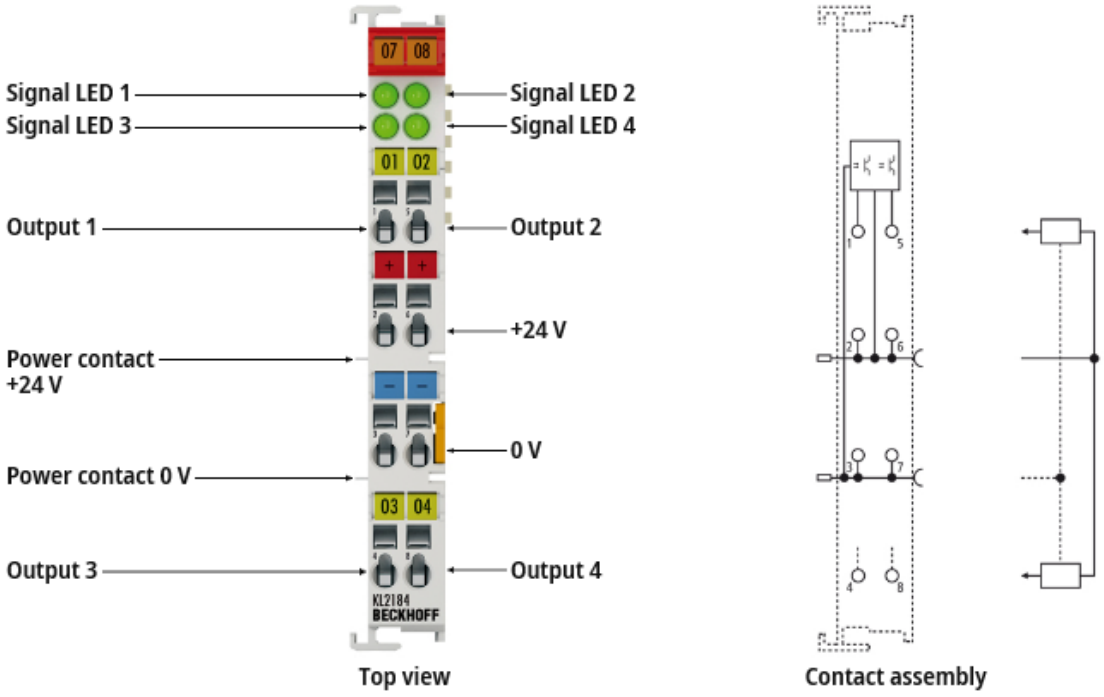


Fig. 17: KL2184 - Contact assignment and LEDs

KL2184 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
+24 V	2	+24 V (internally connected to terminal point 6 and positive power contact)
0 V	3	0 V (internally connected to terminal point 7 and negative power contact)
Output 3	4	Output 3
Output 2	5	Output 2
+24 V	6	+24 V (internally connected to terminal point 2 and positive power contact)
0 V	7	0 V (internally connected to terminal point 3 and negative power contact)
Output 4	8	Output 4

KL2184 - LEDs

LED	Color	Meaning	
Signal LEDs 1 - 4	green	off	Signal voltage "0"
		on	Signal voltage "1"

2.5 KL2212 - Introduction

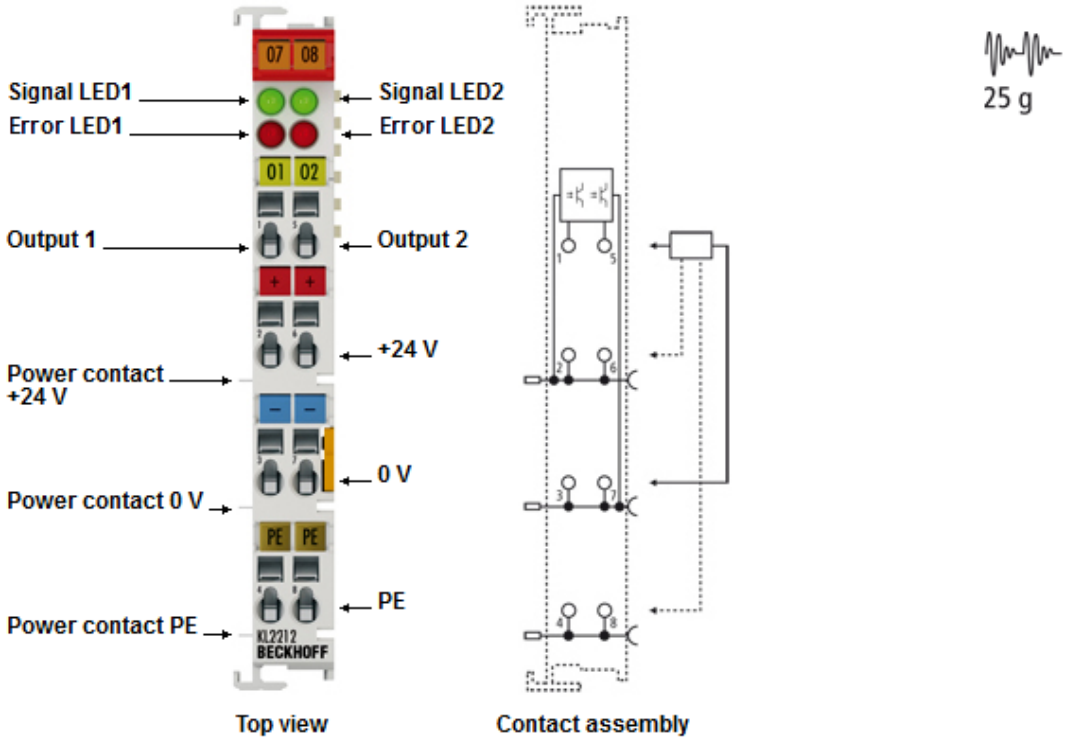


Fig. 18: KL2212 - 2-channel digital output terminal, 24 V_{DC}, 0.5 A, with diagnostics

KL2212 – Bus Terminal, 2-channel digital output, 24 VDC, 0.5 A, with diagnostics

The KL2212 digital output terminal connects the binary control signals from the automation unit on to the actuators at the process level with electrical isolation. The load current output of the KL2212 version is protected against overload and short circuit. A short circuit or an open lead is detected, and the terminal status is relayed to the controller via the K-bus. The Bus Terminals each contain two channels that indicate their signal state and errors by means of light emitting diodes.

Diagnostics per channel

Diagnostic bit 2	Diagnostic bit 1	Error LED red	Signal LED green	Diagnostic message
0	0	0	0	OK
0	1	1	1	short circuit to U_P (V_{CC}), no load (wire break / open load)
1	0	1	0	short circuit to 0 V
1	1	1	0	undervoltage

In case of a short circuit to U_P (V_{CC}) or open lines, although the output is driven, the green and red LED are on.

In case of a short circuit to 0 V (short circuit) the output is switched off. The limit value is 0.95 A.

Undervoltage is present when the applied supply voltage is less than 12 V.

2.5.1 KL2212 - Technical data

Technical data	KL2212, KS2212
Connection technology	4-wire
Number of outputs	2
Nominal voltage	24 V_{DC} (-15 %/+20 %)
Load type	ohmic, inductive, lamp load
output current max.	0,5 A (short-circuit proof) per channel
Short-circuit current	< 2 A
Breaking energy (ind.) max.	< 150 mJ/ channel
Reverse voltage protection	-
Electrical isolation	500 V (K-bus/field potential)
Current consumption power contacts	typ. 15 mA + load
Current consumption K-bus	typ. 15 mA
Bit width in the process image	4 inputs / 4 outputs (2 outputs with no significance)
Configuration	no address or configuration setting
Dimensions (W x H x D)	15 mm x 100 mm x 70 mm (width aligned 12 mm)
Weight	app. 60 g
Mounting [▶ 45]	on 35 mm mounting rail conforms to EN 60715
Permissible ambient temperature during operation	0 °C … +55 °C
Permissible ambient temperature during storage	-25 °C … +85 °C
Permissible relative humidity	95 %, no condensation
Enhanced mechanical load capacity	yes, refer also to Installation instructions for enhanced mechanical load capacity [▶ 48]
Vibration/shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP20
Installation position	variable
Pluggable wiring	for all KSxxxx Bus Terminals
Approvals/markings*	CE, UKCA, cULus, EAC, IECEx [▶ 55], ATEX [▶ 53]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

2.5.2 KL2212 - Contact assignment and LEDs

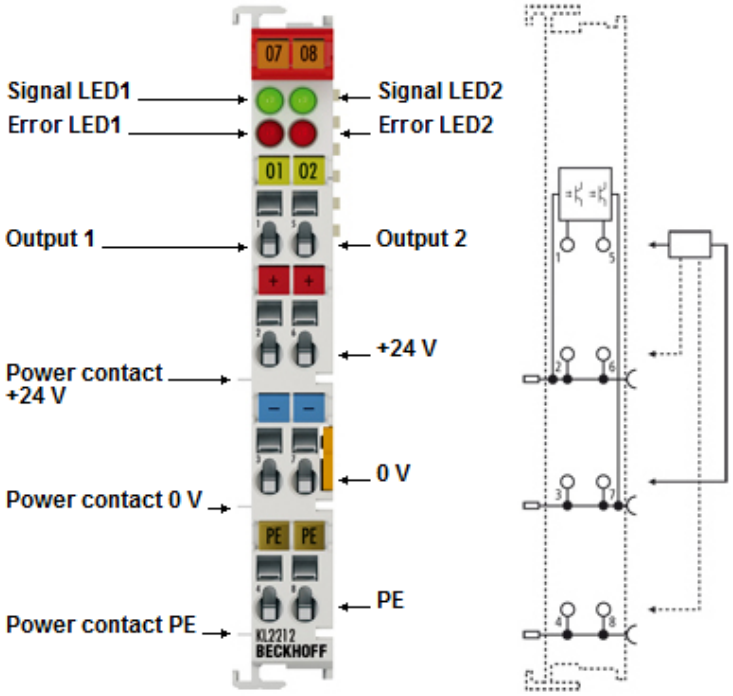


Fig. 19: KL2212 - Contact assignment and LEDs

KL2212 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
+24 V	2	+24 V (internally connected to terminal point 6 and positive power contact)
0 V	3	Ground for output 1 (internally connected to terminal point 7 and negative power contact)
PE	4	PE contact (internally connected to terminal point 8 and PE power contact)
Output 2	5	Output 2
+24 V	6	+24 V (internally connected to terminal point 2 and positive power contact)
0 V	7	Ground for output 2 (internally connected to terminal point 3 and negative power contact)
PE	8	PE contact (internally connected to terminal point 4 and PE power contact)

KL2212 - LEDs

LED	Color	Meaning	
Signal LEDs 1 - 2	green	off	Signal voltage "0"
		on	Signal voltage "1"
Error LEDs 1 - 2	rot	aus	OK
		an	- short circuit to V_{CC}, no load (wire break / open load) - short circuit to 0 V) - undervoltage

2.6 KL2284 - Introduction

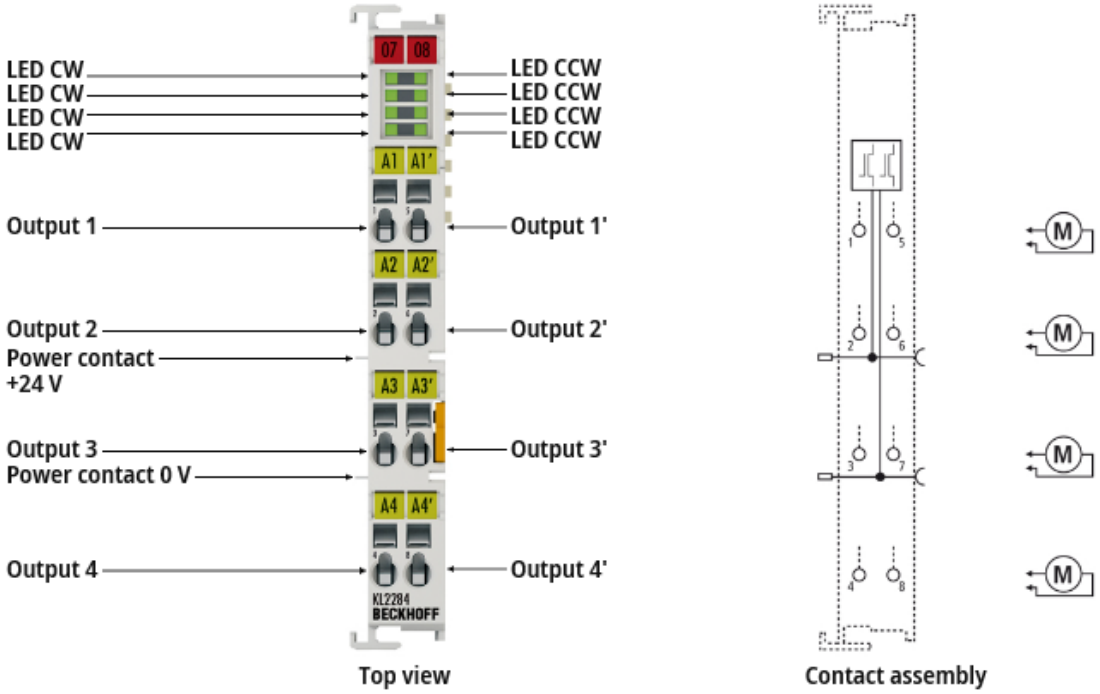


Fig. 20: KL2284 - 4-channel digital output terminal, 24 V_{DC}, 2 A, for reverse switching

KL2284 – Bus Terminal, 4-channel digital output, reverse switching, 24 V_{DC}, 2 A

The KL2284 output terminal switches loads in selectable polarity. This means that DC motors can be used in both directions of rotation. A polarity is switched with two output bits per channel. An interlock prevents simultaneous switching of both directions. Advanced power semiconductors enable safe and wear-free switching with minimum dimensions. The high starting and short circuit currents of the KL2284 are comparable with a robust relay. The number of switching cycles is almost unlimited.

2.6.1 KL2284 - Technical data

Technical data	KL2284, KS2284
Connection technology	2-wire
Number of outputs	4 x H-bridge circuit
Nominal voltage	0 … 24 $V_{AC/DC}$
Max. output current	2 A per channel
Breakdown voltage	80 V
Peak current	5 A (100 ms), < 50 A (10 ms)
Electrical isolation	500 V (K-bus/field potential)
Switching on speed	typ. 235 ms, max. 300 ms
Switching off speed	typ. 30 ms, max. 50 ms
On-resistance	typ. 0,03 Ω
Current consumption K-bus	100 mA
Bit width in the process image	8 outputs
Dimensions (W x H x D)	15 mm x 100 mm x 70 mm (width aligned 12 mm)
Weight	app. 50 g
Mounting [▶ 45]	on 35 mm mounting rail conforms to EN 60715
Permissible ambient temperature during operation	0 … +55 °C
Permissible ambient temperature during storage	-25 … +85 °C
Permissible relative humidity	95 % no condensation
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP20
Installation position	variable
Pluggable wiring	for all KSxxxx Bus Terminals
Approvals/markings*	CE, UKCA, EAC

*) Real applicable approvals/markings see type plate on the side (product marking).

2.6.2 KL2284 - Contact assignment and LEDs

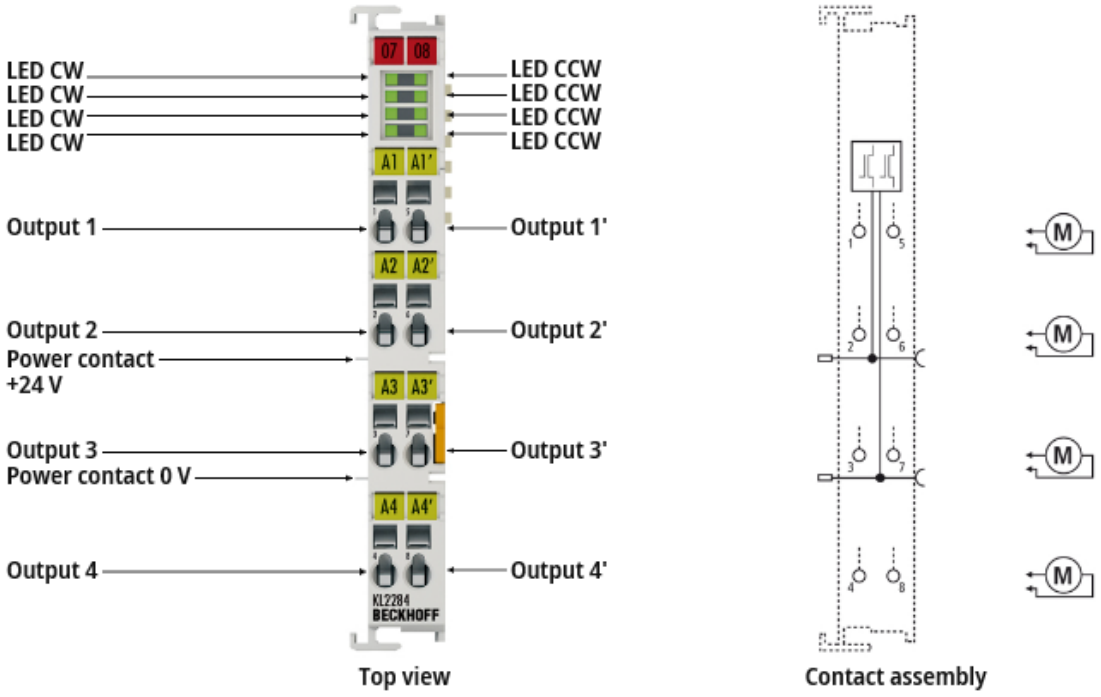


Fig. 21: KL2284 - Contact assignment and LEDs

KL2284 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1 for motor 1
Output 2	2	Output 2 for motor 2
Output 3	3	Output 3 for motor 3
Output 4	4	Output 4 for motor 4
Output 1‘	5	Output 1‘ for motor 1
Output 2‘	6	Output 2‘ for motor 2
Output 3‘	7	Output 3‘ for motor 3
Output 4‘	8	Output 4‘ for motor 4

KL2284 - LEDs

LED	Color	Meaning	
CW1 - CW4	green	on	Motor rotates clockwise
CCW1 - CCW4	green	on	Motor rotates counterclockwise

2.7 KL2404, KL2424 - Introduction

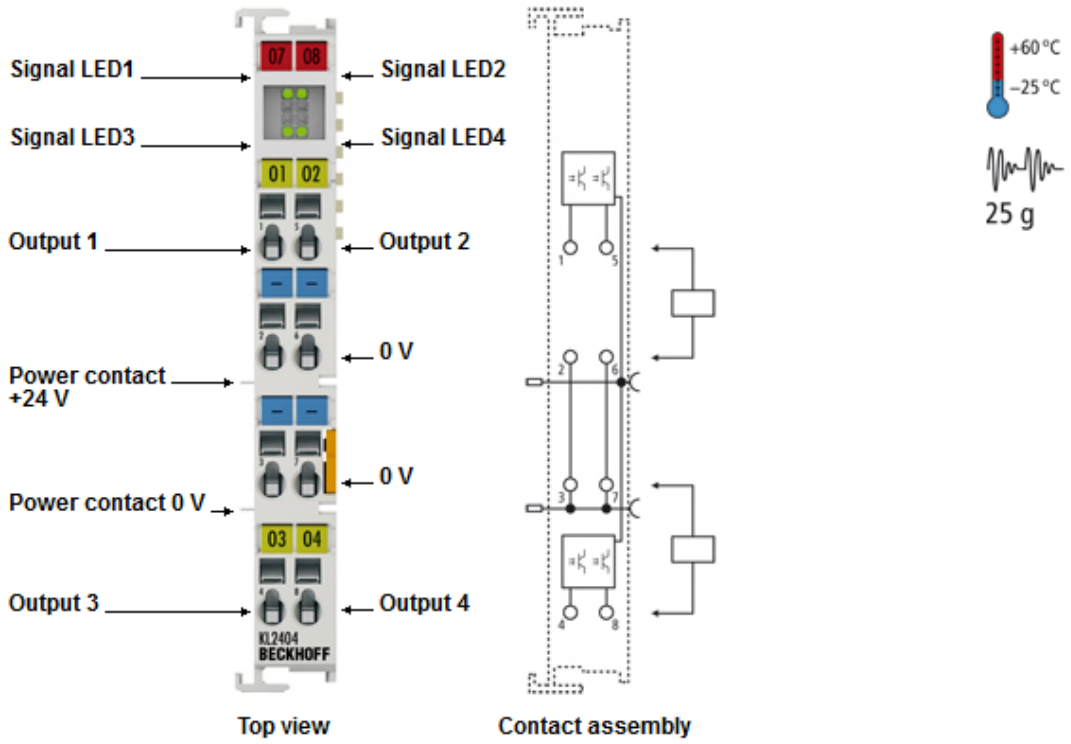


Fig. 22: KL2404 – 4-channel digital output terminal, 24 V_{DC}, 0.5 A

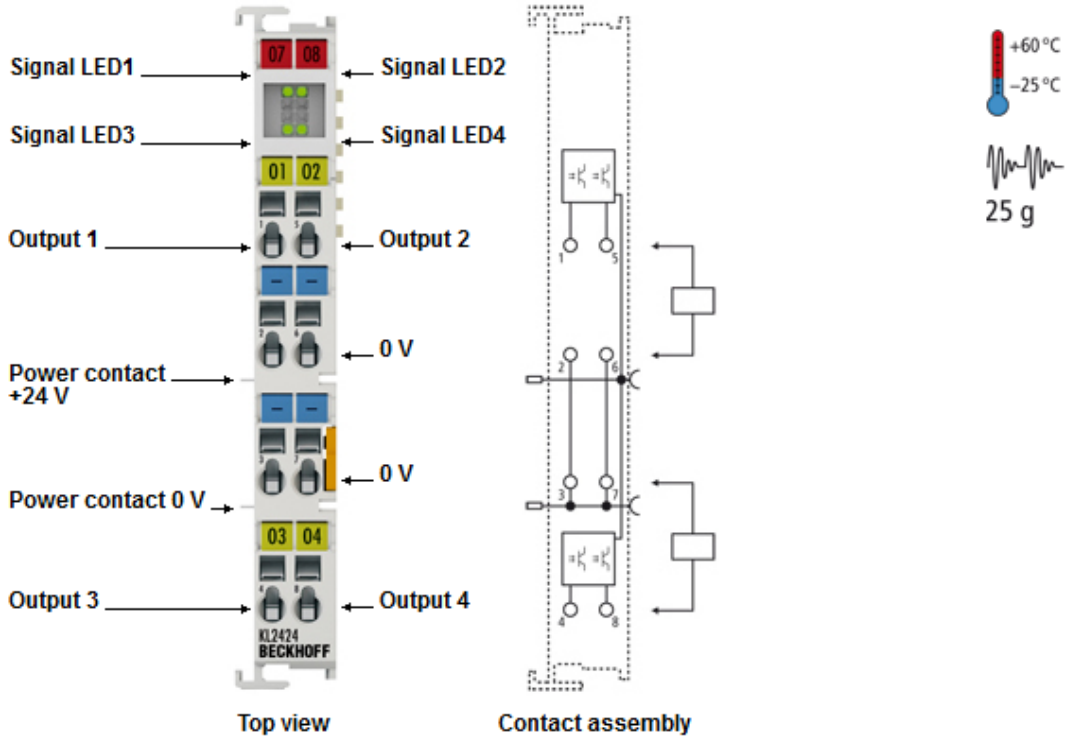


Fig. 23: KL2424 – 4-channel digital output terminal, 24 V_{DC}, 2 A

KL2404, KL2424 – Bus Terminal, 4-channel, digital output, 24 V_{DC}

The KL2404 and KL2424 digital output terminals connect the binary 24 V control signals electrically isolated with the actuators. The Bus Terminals each contain four channels, whose signal states are displayed by LEDs. The variants KL2404 and KL2424 have different maximum output currents. The 4-channel Bus Terminals enable the direct connection of four 2-wire sensors. Four ground connection points are provided.

2.7.1 KL2404, KL2424 - Technical data

Technical data	KL2404, KS2404	KL2424, KS2424
Connection technology	2-wire	
Number of outputs	4	
Nominal voltage	24 V_{DC} (-15 %/+20 %)	
Load type	ohmic, inductive, lamp load	
Max. output current	0.5 A (short-circuit proof) per channel	2.0 A (short-circuit proof) per channel
Short circuit current	< 2 A	< 70 A
Breaking energy (ind.) max.	< 150 mJ/channel	< 1.7 J/channel
Reverse polarity protection	yes	
Electrical isolation	500 V (K-bus / field voltage)	
Current consumption power contacts	typ. 30 mA + load	
K-Bus current consumption	typ. 9 mA	
Bit width in process image	4 outputs	
Configuration	no address or configuration settings required	
Dimensions (W x H x D)	15 mm x 100 mm x 70 mm (width aligned 12 mm)	
Weight	approx. 70 g	
Mounting [▶ 45]	on 35 mm mounting rail conforms to EN 60715	
Permissible ambient temperature during operation	-25°C ... +60°C (extended temperature range)	
Permissible ambient temperature during storage	-40°C ... +85°C	
Permissible relative humidity	95%, no condensation	
Enhanced mechanical load capacity	yes, refer also to Installation instructions for enhanced mechanical load capacity [▶ 48]	
Vibration / shock resistance	according to EN 60068-2-6 / EN 60068-2-27	
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4	
Installation position	variable	
Protection class	IP20	
Pluggable wiring	for all KSxxxx Bus Terminals	
Approvals / markings*	CE, cULus, ATEX [▶ 54], IECEx [▶ 55]	CE, cULus, GL, ATEX [▶ 54], IECEx [▶ 55]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

2.7.2 KL2404 - Contact assignment and LEDs

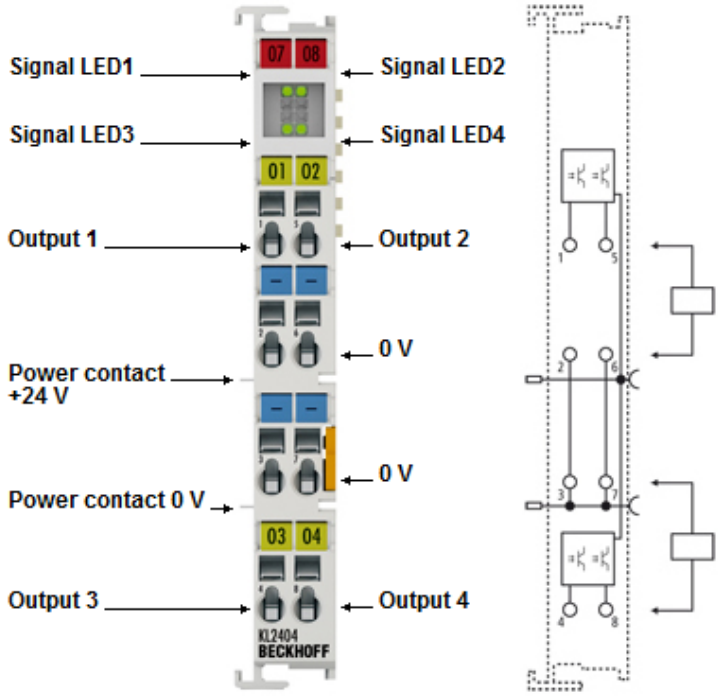


Fig. 24: KL2404 - Contact assignment and LEDs

KL2404 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
0 V	2	Ground for output 1 (internally connected to terminal point 3, 6, 7 and negative power contact)
0 V	3	Ground for output 3 (internally connected to terminal point 2, 6, 7 and negative power contact)
Output 3	4	Output 3
Output 2	5	Output 2
0 V	6	Ground for output 2 (internally connected to terminal point 2, 3, 7 and negative power contact)
0 V	7	Ground for output 4 (internally connected to terminal point 2, 3, 6 and negative power contact)
Output 4	8	Output 4

KL2404 - LEDs

LED	Color	Meaning	
Signal LEDs 1 - 4	green	off	Signal voltage "0"
		on	Signal voltage "1"

2.7.3 KL2424 - Contact assignment and LEDs

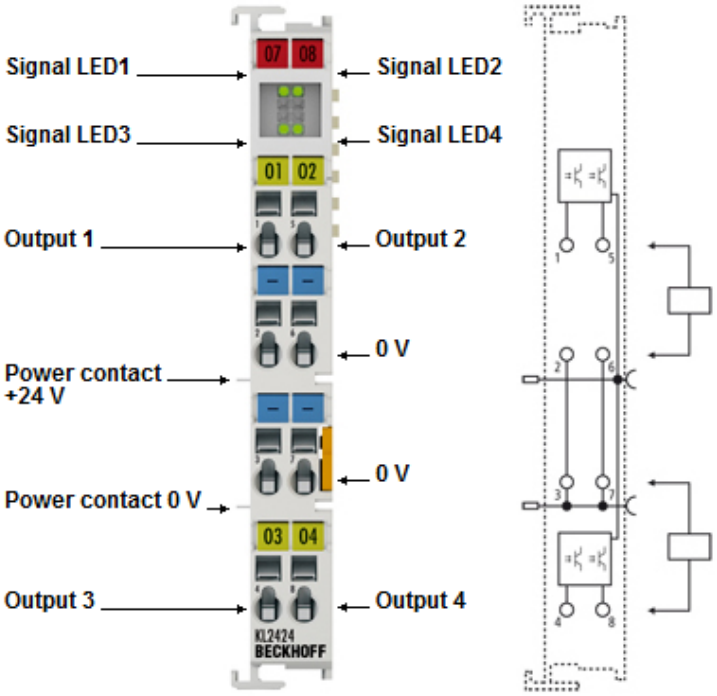


Fig. 25: KL2424 - Contact assignment and LEDs

KL2424 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
0 V	2	Ground for output 1 (internally connected to terminal point 3, 6, 7 and negative power contact)
0 V	3	Ground for output 3 (internally connected to terminal point 2, 6, 7 and negative power contact)
Output 3	4	Output 3
Output 2	5	Output 2
0 V	6	Ground for output 2 (internally connected to terminal point 2, 3, 7 and negative power contact)
0 V	7	Ground for output 4 (internally connected to terminal point 2, 3, 6 and negative power contact)
Output 4	8	Output 4

KL2424 - LEDs

LED	Color	Meaning	
Signal LEDs 1 - 4	green	off	Signal voltage "0"
		on	Signal voltage "1"

2.8 KL2408, KL2488 - Introduction

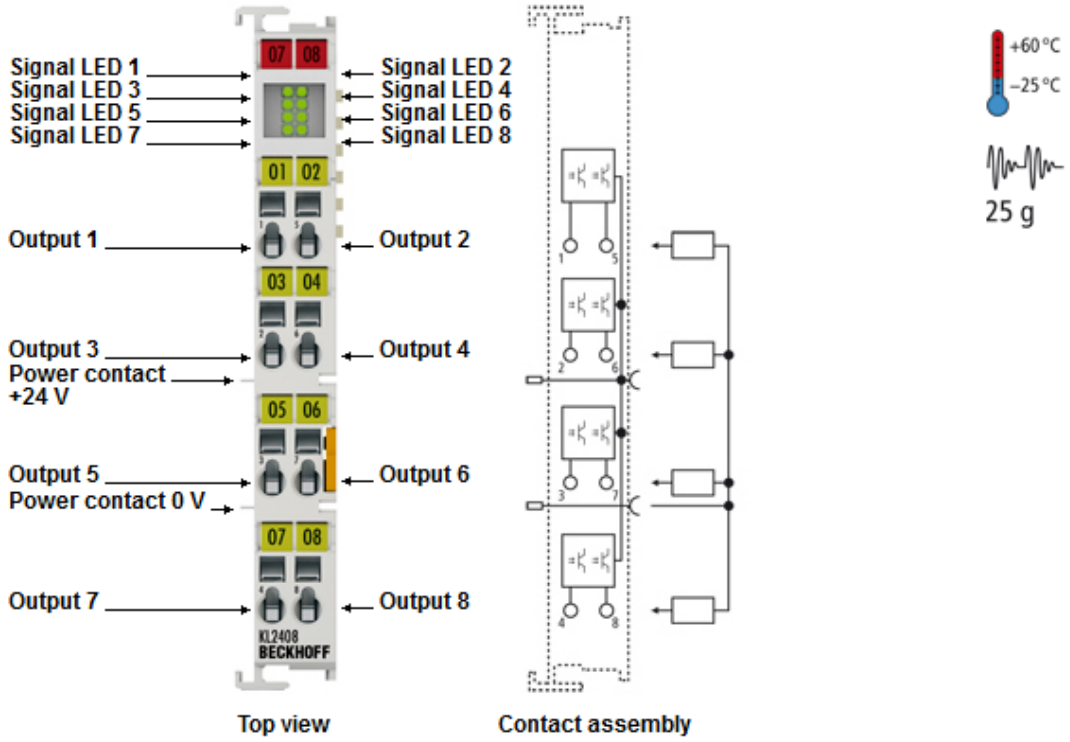


Fig. 26: KL2408 - 8-channel digital output terminal, 24 V_{DC}, 0.5 A

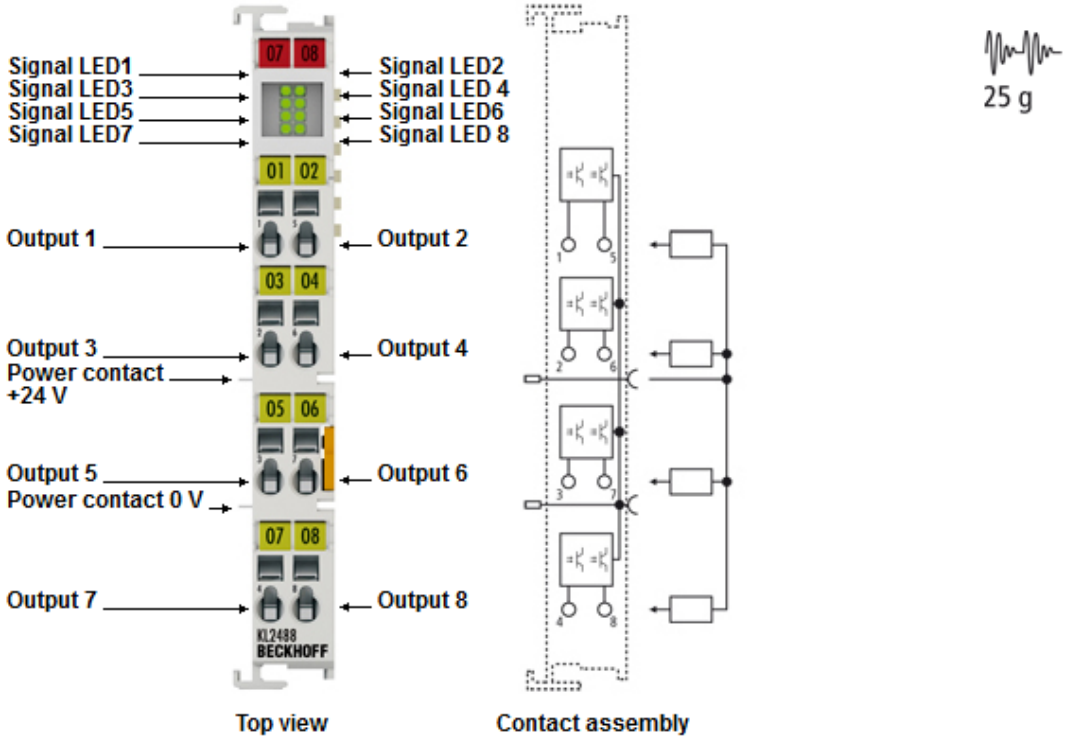


Fig. 27: KL2488 - 8-channel digital output terminal, 24 V_{DC}, 0.5 A, ground switching

KL2408, KL2488 – Bus Terminal, 8-channel, digital output, 24 V_{DC}

The KL2408 (positive switching) and KL2488 (mass-switching) digital output terminals connect the binary control signals from the automation unit on to the actuators at the process level with electrical isolation. The KL2408/KL2488 variants are protected against reverse polarity connection. They handle load currents with outputs that are protected against overload and short circuit. The Bus Terminals contain eight channels which indicate their signal state by means of light emitting diodes. They are particularly suitable for space-saving use in control cabinets. The connection technology is particularly suitable for single-ended inputs. All components have to use the same reference point as the KL2408 or KL2488. The power contacts are looped through. In the KL2408 terminal, the outputs are supplied by the 24 V power contact. In the KL2488 terminal, they are supplied via the 0 V power contact.

2.8.1 KL2408, KL2488 - Technical data

Technical data	KL2408, KS2408	KL2488, KS2488
Connection technology	1-wire	
Number of outputs	8 (positive switching)	8 (mass-switching)
Nominal voltage	24 V_{DC} (-15 %/+20 %)	
Load type	ohmic, inductive, lamp load	
Max. output current	0.5 A (short-circuit proof) per channel	
Short circuit current	< 2 A	< 7 A
Breaking energy (ind.) max.	< 150 mJ/channel	< 100 mJ/channel
Reverse polarity protection	yes	
Electrical isolation	500 V (K-bus / field voltage)	
K-Bus current consumption	typ. 18 mA	
Current consumption power contacts	typ. 60 mA + load	
Bit width in process image	8 outputs	
Configuration	no address or configuration settings required	
Dimensions (W x H x D)	15 mm x 100 mm x 70 mm (width aligned 12 mm)	
Weight	approx. 70 g	
Mounting [▶ 45]	on 35 mm mounting rail conforms to EN 60715	
Permissible ambient temperature during operation	-25°C ... +60°C (extended temperature range)	0°C … +55°C
Permissible ambient temperature during storage	-40°C ... +85°C	-25°C … +85°C
Permissible relative humidity	95%, no condensation	
Enhanced mechanical load capacity	yes, refer also to Installation instructions for enhanced mechanical load capacity [▶ 48]	
Vibration / shock resistance	according to EN 60068-2-6 / EN 60068-2-27	
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4	
Installation position	variable	
Protection class	IP20	
Pluggable wiring	for all KSxxxx Bus Terminals	
Approvals / markings*	CE, cULus, GL, ATEX [▶ 54], IECEx [▶ 55], cFMus [▶ 57]	CE, cULus, ATEX [▶ 53], IECEx [▶ 55]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	KL2408, KS2408	KL2488, KS2488
ATEX	II 3 G Ex nA IIC T4 Gc II 3 D Ex tc IIIC T135 °C Dc	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc Ex tc IIIC T135 °C Dc	-
cFMus	Class I, Division 2, Groups A, B, C, D Class I, Zone 2, AEx/Ex ec IIC T4 Gc	-

2.8.2 KL2408 - Contact assignment and LEDs

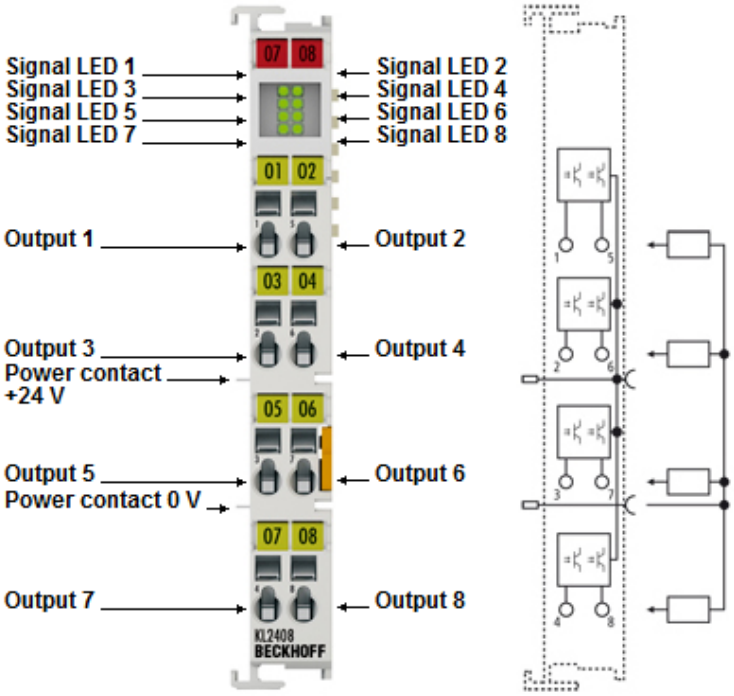


Fig. 28: KL2408 – Contact assignment and LEDs

KL2408 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
Output 3	2	Output 3
Output 5	3	Output 5
Output 7	4	Output 7
Output 2	5	Output 2
Output 4	6	Output 4
Output 6	7	Output 6
Output 8	8	Output 8

KL2408 - LEDs

LED	Color	Meaning	
Signal LED 1 - 8	green	off	Signal voltage "0"
		on	Signal voltage "1"

2.8.3 KL2488 - Contact assignment and LEDs

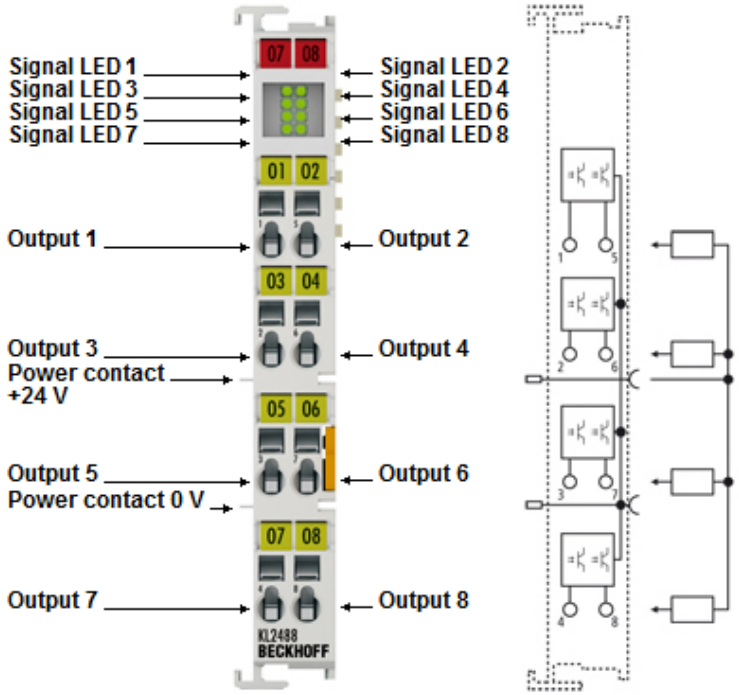


Fig. 29: KL2488 - Contact assignment and LEDs

KL2488 - Contact assignment

Terminal point		Description
Name	No.	
Output 1	1	Output 1
Output 3	2	Output 3
Output 5	3	Output 5
Output 7	4	Output 7
Output 2	5	Output 2
Output 4	6	Output 4
Output 6	7	Output 6
Output 8	8	Output 8

KL2488 - LEDs

LED	Color	Meaning	
Signal LED 1 - 8	green	off	Signal voltage "0"
		on	Signal voltage "1"

3 Mounting and wiring

3.1 Instructions for ESD protection

NOTICE

Destruction of the devices by electrostatic discharge possible!

The devices contain components at risk from electrostatic discharge caused by improper handling.

- Please ensure you are electrostatically discharged and avoid touching the spring contacts (see fig.) of the device directly.
- Avoid contact with highly insulating materials (synthetic fibers, plastic film etc.).
- Surroundings (working place, packaging and personnel) should by grounded probably, when handling with the devices.
- Each assembly must be terminated at the right hand end with a KL9010 bus end terminal, to ensure the protection class and ESD protection.

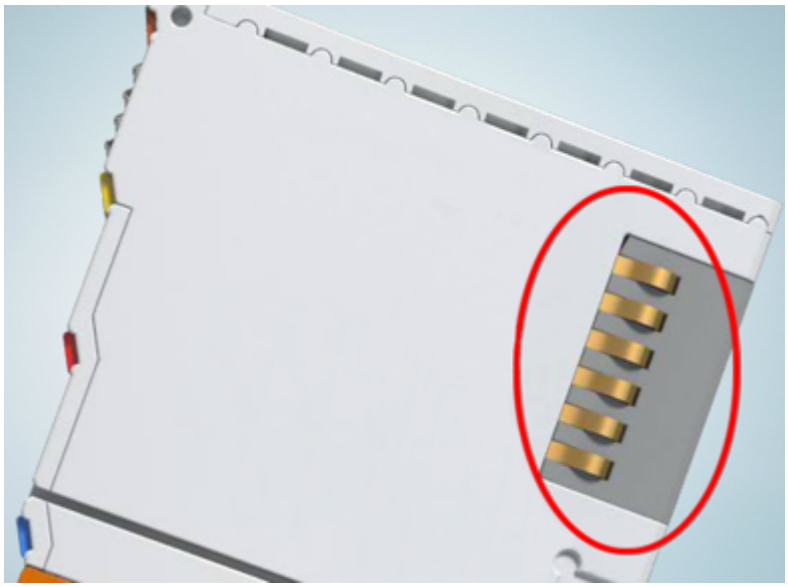


Fig. 30: Spring contacts of the Beckhoff I/O components

3.2 Installation on mounting rails

⚠ WARNING

Risk of electric shock and damage of device!

Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the bus terminals!

The Bus Terminal system and is designed for mounting in a control cabinet or terminal box.

Assembly

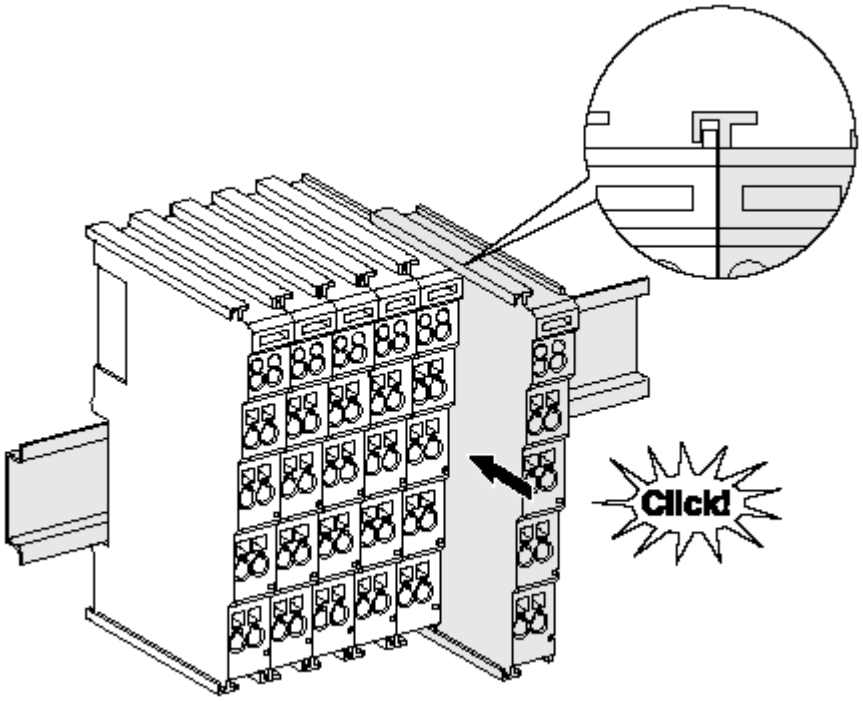


Fig. 31: Attaching on mounting rail

The bus coupler and bus terminals are attached to commercially available 35 mm mounting rails (DIN rails according to EN 60715) by applying slight pressure:

1. First attach the fieldbus coupler to the mounting rail.
2. The bus terminals are now attached on the right-hand side of the fieldbus coupler. Join the components with tongue and groove and push the terminals against the mounting rail, until the lock clicks onto the mounting rail.
   If the terminals are clipped onto the mounting rail first and then pushed together without tongue and groove, the connection will not be operational! When correctly assembled, no significant gap should be visible between the housings.

Fixing of mounting rails

The locking mechanism of the terminals and couplers extends to the profile of the mounting rail. At the installation, the locking mechanism of the components must not come into conflict with the fixing bolts of the mounting rail. To mount the mounting rails with a height of 7.5 mm under the terminals and couplers, you should use flat mounting connections (e.g. countersunk screws or blind rivets).

Disassembly

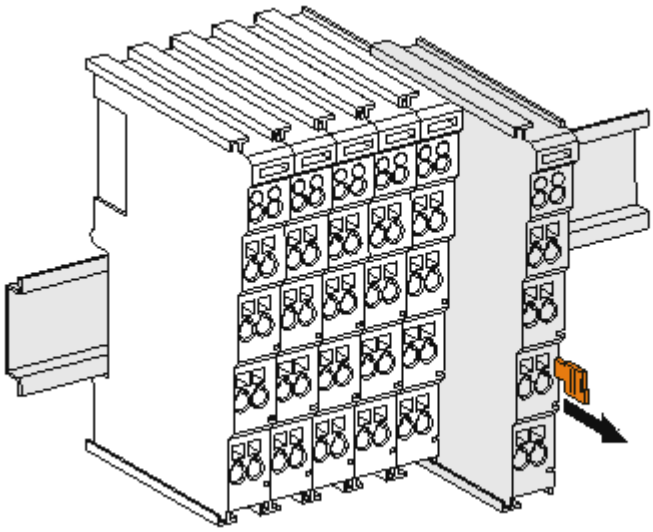


Fig. 32: Disassembling of terminal

Each terminal is secured by a lock on the mounting rail, which must be released for disassembly:

1. Pull the terminal by its orange-colored lugs approximately 1 cm away from the mounting rail. In doing so for this terminal the mounting rail lock is released automatically and you can pull the terminal out of the bus terminal block easily without excessive force.
2. Grasp the released terminal with thumb and index finger simultaneous at the upper and lower grooved housing surfaces and pull the terminal out of the bus terminal block.

Connections within a bus terminal block

The electric connections between the Bus Coupler and the Bus Terminals are automatically realized by joining the components:

- The six spring contacts of the K-Bus/E-Bus deal with the transfer of the data and the supply of the Bus Terminal electronics.
- The power contacts deal with the supply for the field electronics and thus represent a supply rail within the bus terminal block. The power contacts are supplied via terminals on the Bus Coupler (up to 24 V) or for higher voltages via power feed terminals.

Power Contacts

During the design of a bus terminal block, the pin assignment of the individual Bus Terminals must be taken account of, since some types (e.g. analog Bus Terminals or digital 4-channel Bus Terminals) do not or not fully loop through the power contacts. Power Feed Terminals (KL91xx, KL92xx or EL91xx, EL92xx) interrupt the power contacts and thus represent the start of a new supply rail.

PE power contact

The power contact labeled PE can be used as a protective earth. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.

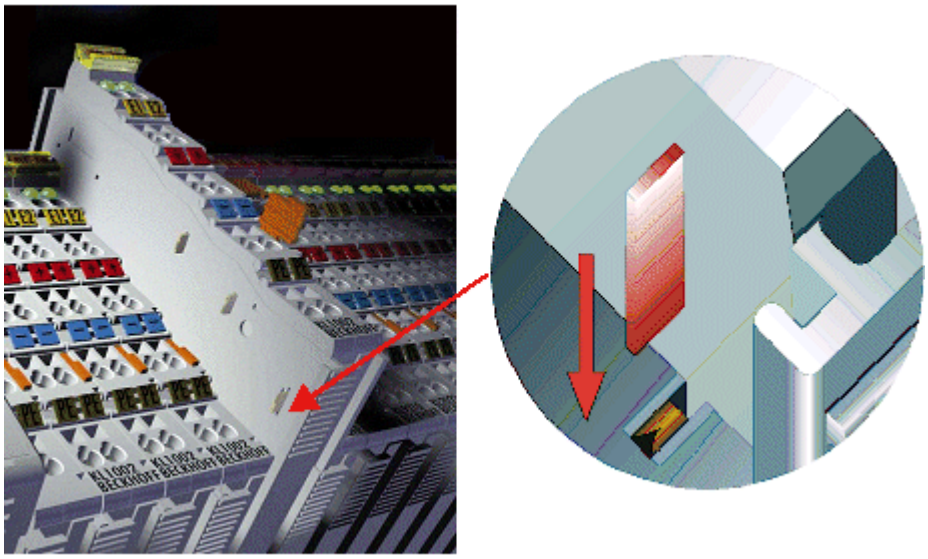


Fig. 33: Power contact on left side

NOTICE

Possible damage of the device

Note that, for reasons of electromagnetic compatibility, the PE contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the PE line during insulation testing of a consumer with a nominal voltage of 230 V). For insulation testing, disconnect the PE supply line at the Bus Coupler or the Power Feed Terminal! In order to decouple further feed points for testing, these Power Feed Terminals can be released and pulled at least 10 mm from the group of terminals.

⚠ WARNING

Risk of electric shock!

The PE power contact must not be used for other potentials!

3.3 Disposal

Products marked with a crossed-out wheeled bin shall not be discarded with the normal waste stream. The device is considered as waste electrical and electronic equipment. The national regulations for the disposal of waste electrical and electronic equipment must be observed.

3.4 Installation instructions for enhanced mechanical load capacity

⚠ WARNING

Risk of injury through electric shock and damage to the device!

Bring the Bus Terminal system into a safe, de-energized state before starting mounting, disassembly or wiring of the Bus Terminals!

Additional checks

The terminals have undergone the following additional tests:

Verification	Explanation
Vibration	10 frequency runs in 3 axes
	6 Hz < f < 60 Hz displacement 0.35 mm, constant amplitude
	60.1 Hz < f < 500 Hz acceleration 5 *g*, constant amplitude
Shocks	1000 shocks in each direction, in 3 axes
	25 *g*, 6 ms

Additional installation instructions

For terminals with enhanced mechanical load capacity, the following additional installation instructions apply:

- The enhanced mechanical load capacity is valid for all permissible installation positions
- Use a mounting rail according to EN 60715 TH35-15
- Fix the terminal segment on both sides of the mounting rail with a mechanical fixture, e.g. an earth terminal or reinforced end clamp
- The maximum total extension of the terminal segment (without coupler) is:
  64 terminals (12 mm mounting with) or 32 terminals (24 mm mounting with)
- Avoid deformation, twisting, crushing and bending of the mounting rail during edging and installation of the rail
- The mounting points of the mounting rail must be set at 5 cm intervals
- Use countersunk head screws to fasten the mounting rail
- The free length between the strain relief and the wire connection should be kept as short as possible. A distance of approx. 10 cm should be maintained to the cable duct.

3.5 Connection

3.5.1 Connection system

⚠ WARNING

Risk of electric shock and damage of device!

Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the bus terminals!

Overview

The bus terminal system offers different connection options for optimum adaptation to the respective application:

- The terminals of ELxxxx and KLxxxx series with standard wiring include electronics and connection level in a single enclosure.
- The terminals of ESxxxx and KSxxxx series feature a pluggable connection level and enable steady wiring while replacing.

- The High Density Terminals (HD Terminals) include electronics and connection level in a single enclosure and have advanced packaging density.

Standard wiring (ELxxxx / KLxxxx)

Fig. 34: Standard wiring

The terminals of ELxxxx and KLxxxx series have been tried and tested for years.
They feature integrated screwless spring force technology for fast and simple assembly.

Pluggable wiring (ESxxxx / KSxxxx)

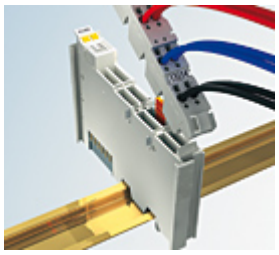


Fig. 35: Pluggable wiring

The terminals of ESxxxx and KSxxxx series feature a pluggable connection level.
The assembly and wiring procedure is the same as for the ELxxxx and KLxxxx series.
The pluggable connection level enables the complete wiring to be removed as a plug connector from the top of the housing for servicing.
The lower section can be removed from the terminal block by pulling the unlocking tab.
Insert the new component and plug in the connector with the wiring. This reduces the installation time and eliminates the risk of wires being mixed up.

The familiar dimensions of the terminal only had to be changed slightly. The new connector adds about 3 mm. The maximum height of the terminal remains unchanged.

A tab for strain relief of the cable simplifies assembly in many applications and prevents tangling of individual connection wires when the connector is removed.

Conductor cross sections between 0.08 mm^2 and 2.5 mm^2 can continue to be used with the proven spring force technology.

The overview and nomenclature of the product names for ESxxxx and KSxxxx series has been retained as known from ELxxxx and KLxxxx series.

High Density Terminals (HD Terminals)

Fig. 36: High Density Terminals

The terminals from these series with 16 terminal points are distinguished by a particularly compact design, as the packaging density is twice as large as that of the standard 12 mm bus terminals. Massive conductors and conductors with a wire end sleeve can be inserted directly into the spring loaded terminal point without tools.

Wiring HD Terminals

The High Density Terminals of the ELx8xx and KLx8xx series doesn't support pluggable wiring.

Ultrasonically “bonded” (ultrasonically welded) conductors

Ultrasonically “bonded” conductors

It is also possible to connect the Standard and High Density Terminals with ultrasonically “bonded” (ultrasonically welded) conductors. In this case, please note the tables concerning the wire-size width [▶ 51]!

3.5.2 Wiring

⚠ WARNING

Risk of electric shock and damage of device!

Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the bus terminals!

Terminals for standard wiring ELxxxx/KLxxxx and for pluggable wiring ESxxxx/KSxxxx

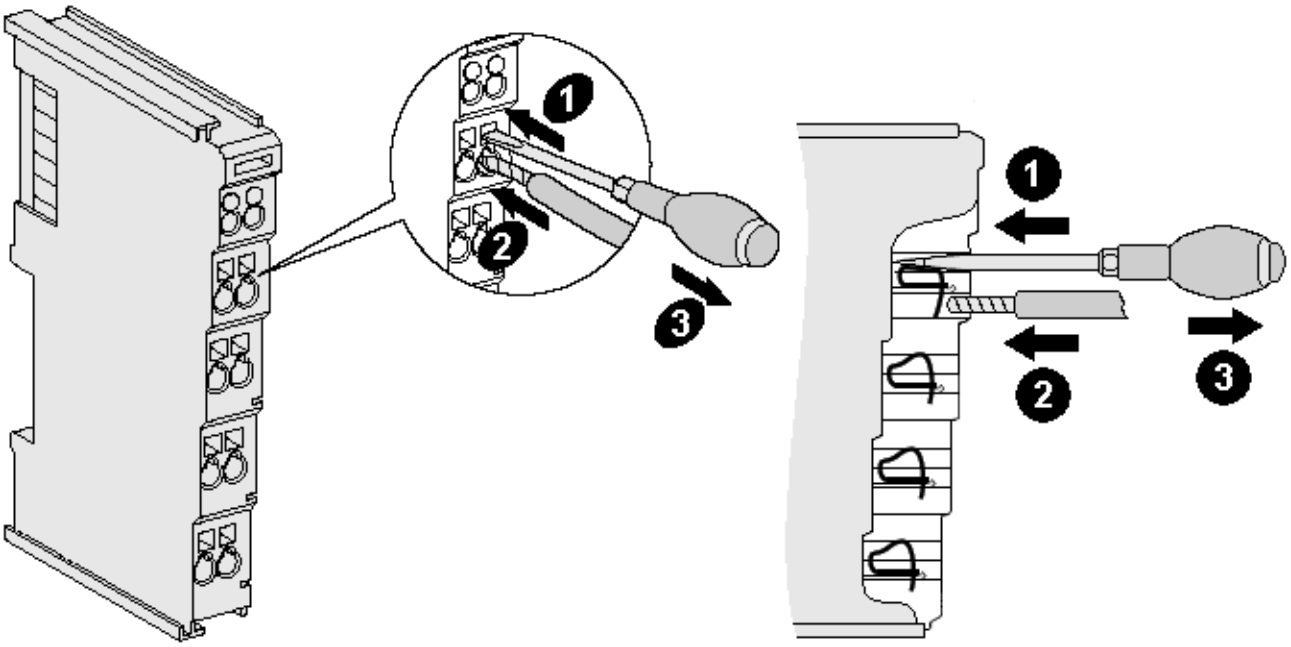


Fig. 37: Connecting a cable on a terminal point

Up to eight terminal points enable the connection of solid or finely stranded cables to the bus terminal. The terminal points are implemented in spring force technology. Connect the cables as follows:

1. Open a terminal point by pushing a screwdriver straight against the stop into the square opening above the terminal point. Do not turn the screwdriver or move it alternately (don't toggle).
2. The wire can now be inserted into the round terminal opening without any force.
3. The terminal point closes automatically when the pressure is released, holding the wire securely and permanently.

See the following table for the suitable wire size width.

Terminal housing	ELxxxx, KLxxxx	ESxxxx, KSxxxx
Wire size width (single core wires)	0.08 ... 2.5 mm²	0.08 ... 2.5 mm²
Wire size width (fine-wire conductors)	0.08 ... 2.5 mm²	0.08 ... 2.5 mm²
Wire size width (conductors with a wire end sleeve)	0.14 ... 1.5 mm²	0.14 ... 1.5 mm²
Wire stripping length	8 ... 9 mm	9 ... 10 mm

High Density Terminals (HD Terminals [▶ 49]) with 16 terminal points

The conductors of the HD Terminals are connected without tools for single-wire conductors using the direct plug-in technique, i.e. after stripping the wire is simply plugged into the terminal point. The cables are released, as usual, using the contact release with the aid of a screwdriver. See the following table for the suitable wire size width.

Terminal housing	High Density Housing
Wire size width (single core wires)	0.08 ... 1.5 mm^2
Wire size width (fine-wire conductors)	0.25 ... 1.5 mm^2
Wire size width (conductors with a wire end sleeve)	0.14 ... 0.75 mm^2
Wire size width (ultrasonically “bonded" conductors)	only 1.5 mm^2 (see notice [▶ 50])
Wire stripping length	8 ... 9 mm

3.5.3 Shielding

Shielding

Encoder, analog sensors and actuators should always be connected with shielded, twisted paired wires.

3.6 ATEX - Special conditions (standard temperature range)

⚠ WARNING

Observe the special conditions for the intended use of Beckhoff fieldbus components with standard temperature range in potentially explosive areas (directive 2014/34/EU)!

- The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60079-15! The environmental conditions during use are thereby to be taken into account!
- For dust (only the fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9): The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to EN 60079-31 for group IIIA or IIIB and IP6X for group IIIC, taking into account the environmental conditions under which the equipment is used!
- If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
- Observe the permissible ambient temperature range of 0 to 55°C for the use of Beckhoff fieldbus components standard temperature range in potentially explosive areas!
- Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages!
- The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- EN 60079-0:2012+A11:2013
- EN 60079-15:2010
- EN 60079-31:2013 (only for certificate no. KEMA 10ATEX0075 X Issue 9)

Marking

The Beckhoff fieldbus components with standard temperature range certified according to the ATEX directive for potentially explosive areas bear one of the following markings:

II 3G KEMA 10ATEX0075 X Ex nA IIC T4 Gc Ta: 0 … +55°C

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: 0 ... +55°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

or

II 3G KEMA 10ATEX0075 X Ex nA nC IIC T4 Gc Ta: 0 … +55°C

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: 0 ... +55°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

3.7 ATEX - Special conditions (extended temperature range)

⚠ WARNING

Observe the special conditions for the intended use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas (directive 2014/34/EU)!

- The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60079-15! The environmental conditions during use are thereby to be taken into account!
- For dust (only the fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9): The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to EN 60079-31 for group IIIA or IIIB and IP6X for group IIIC, taking into account the environmental conditions under which the equipment is used!
- If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
- Observe the permissible ambient temperature range of -25 to 60°C for the use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas!
- Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages!
- The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- EN 60079-0:2012+A11:2013
- EN 60079-15:2010
- EN 60079-31:2013 (only for certificate no. KEMA 10ATEX0075 X Issue 9)

Marking

The Beckhoff fieldbus components with extended temperature range (ET) certified according to the ATEX directive for potentially explosive areas bear the following marking:

II 3G KEMA 10ATEX0075 X Ex nA IIC T4 Gc Ta: -25 … +60°C

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: -25 ... +60°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

or

II 3G KEMA 10ATEX0075 X Ex nA nC IIC T4 Gc Ta: -25 … +60°C

II 3D KEMA 10ATEX0075 X Ex tc IIIC T135°C Dc Ta: -25 ... +60°C
(only for fieldbus components of certificate no. KEMA 10ATEX0075 X Issue 9)

3.8 IECEx - Special conditions

⚠ WARNING

Observe the special conditions for the intended use of Beckhoff fieldbus components in potentially explosive areas!

- For gas: The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to IEC 60079-15, taking into account the environmental conditions under which the equipment is used!
- For dust (only the fieldbus components of certificate no. IECEx DEK 16.0078X Issue 3):
  The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to EN 60079-31 for group IIIA or IIIB and IP6X for group IIIC, taking into account the environmental conditions under which the equipment is used!
- The equipment shall only be used in an area of at least pollution degree 2, as defined in IEC 60664-1!
- Provisions shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 119 V!
- If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
- Observe the permissible ambient temperature range for the use of Beckhoff fieldbus components in potentially explosive areas!
- The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The front hatch of certified units may only be opened if the supply voltage has been switched off or a non-explosive atmosphere is ensured!

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- EN 60079-0:2011
- EN 60079-15:2010
- EN 60079-31:2013 (only for certificate no. IECEx DEK 16.0078X Issue 3)

Marking

Beckhoff fieldbus components that are certified in accordance with IECEx for use in areas subject to an explosion hazard bear the following markings:

Marking for fieldbus components of certificate no. IECEx DEK 16.0078X Issue 3:	**IECEx DEK 16.0078 X** **Ex nA IIC T4 Gc** **Ex tc IIIC T135°C Dc**
Marking for fieldbus components of certficates with later issues:	**IECEx DEK 16.0078 X** **Ex nA IIC T4 Gc**

3.9 Continuative documentation for ATEX and IECEx

NOTICE	
	**Continuative documentation about explosion protection according to ATEX and IECEx** Pay also attention to the continuative documentation **Ex. Protection for Terminal Systems** Notes on the use of the Beckhoff terminal systems in hazardous areas according to ATEX and IECEx, that is available for download within the download area of your product on the Beckhoff homepage www.beckhoff.com!

3.10 cFMus - Special conditions

⚠ WARNING

Observe the special conditions for the intended use of Beckhoff fieldbus components in potentially explosive areas!

- The equipment shall be installed within an enclosure that provides a minimum ingress protection of IP54 in accordance with ANSI/UL 60079-0 (US) or CSA C22.2 No. 60079-0 (Canada).
- The equipment shall only be used in an area of at least pollution degree 2, as defined in IEC 60664-1.
- Transient protection shall be provided that is set at a level not exceeding 140% of the peak rated voltage value at the supply terminals to the equipment.
- The circuits shall be limited to overvoltage Category II as defined in IEC 60664-1.
- The Fieldbus Components may only be removed or inserted when the system supply and the field supply are switched off, or when the location is known to be non-hazardous.
- The Fieldbus Components may only be disconnected or connected when the system supply is switched off, or when the location is known to be non-hazardous.

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

M20US0111X (US):

- FM Class 3600:2018
- FM Class 3611:2018
- FM Class 3810:2018
- ANSI/UL 121201:2019
- ANSI/ISA 61010-1:2012
- ANSI/UL 60079-0:2020
- ANSI/UL 60079-7:2017

FM20CA0053X (Canada):

- CAN/CSA C22.2 No. 213-17:2017
- CSA C22.2 No. 60079-0:2019
- CAN/CSA C22.2 No. 60079-7:2016
- CAN/CSA C22.2 No.61010-1:2012

Marking

Beckhoff fieldbus components that are certified in accordance with cFMus for use in areas subject to an explosion hazard bear the following markings:

FM20US0111X (US):	**Class I, Division 2, Groups A, B, C, D** **Class I, Zone 2, AEx ec IIC T4 Gc**
FM20CA0053X (Canada):	**Class I, Division 2, Groups A, B, C, D** **Ex ec T4 Gc**

3.11 Continuative documentation for cFMus

NOTICE

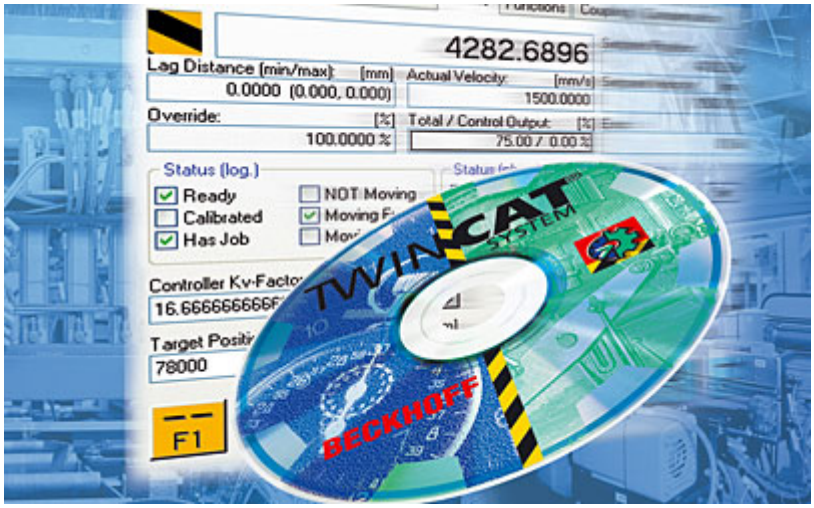
Continuative documentation about explosion protection according to cFMus

Pay also attention to the continuative documentation

Control Drawing I/O, CX, CPX
Connection diagrams and Ex markings,

that is available for download within the download area of your product on the Beckhoff homepage www.beckhoff.com!

4 TwinCAT



PLC and Motion Control on the PC

TwinCAT - **T**he **Win**dows **C**ontrol and **A**utomation **T**echnology

The TwinCAT automation software converts any compatible PC into a real-time controller with multi-PLC, NC axis control, programming environment and operating station. TwinCAT replaces conventional PLC and NC controllers as well as operating devices:

- open, compatible PC hardware
- Embedding of IEC 61131-3 software PLC, software NC and software CNC in Windows
- Programming and runtime systems optionally together on one PC or separated
- Connection to all common fieldbus systems
- PC interfaces are supported
- Data communication with user interfaces and other programs by means of open Microsoft standards (OPC, OCX, DLL, etc.)

TwinCAT architecture

TwinCAT consists of runtime systems for real-time execution of control programs and development environments for programming, diagnosis and configuration. Any Windows programs, for instance visualization programs or Office programs, can access TwinCAT data via Microsoft interfaces, or can execute commands.

A practically oriented software solution

TwinCAT offers a precise time-base in which programs are executed with the highest deterministic features, independently of other processor tasks. The real-time load on a PC is set with TwinCAT: This achieves a defined operating behavior. TwinCAT displays the system load for running programs. A loading threshold can be set, in order to assure a defined computing capacity for the operating programs and for Windows. If this threshold is exceeded, a system message is generated.

TwinCAT supports system diagnosis

The general use of hardware and software from the open PC world requires some checking: Unsuitable components can upset the PC system. Beckhoff integrates a handy display of the real-time jitter in order to provide administrators with a simple means of evaluating hardware and software. A system message during operation can draw attention to error states.

Start/stop behavior

Depending on the setting, TwinCAT is started and stopped manually or automatically. Since TwinCAT is integrated into Windows as a service, an operator is not needed to start the system: switching on is enough.

Restarting and data backup

When a program is started or restarted, TwinCAT loads programs and remanent data. To backup data, and to shut down Windows correctly, a UPS (uninterruptible power supply) is of great value.

TwinCAT and "Blue Screen"

The TwinCAT system can be configured such that real-time capability is maintained in the event of a BSOD (Blue-Screen-of-Death) operating system crash. Real-time tasks such as PLC and NC can thus continue to run and place the controlled process in a safe state. Ultimately, it is the decision of the programmer whether or not to utilize this feature, bearing in mind that data or programs may already have been destroyed by the BSOD.

World-wide connection through message routing - "remote" connection is inherent to the system

According to the requirement for operating resources, the TwinCAT software devices can be distributed: TwinCAT PLC programs can be executed on PCs and on Beckhoff Bus Terminal controllers. A "message router" manages and distributes all the messages, both in the system and via TCP/IP connections. PC systems can be connected to one another by TCP/IP; Bus Terminal controllers are connected via serial interfaces and fieldbus systems (EtherCAT, Lightbus, PROFIBUS DP, PROFINET, Interbus, CANopen, DeviceNet, RS232, RS485, Ethernet TCP/IP, Ethernet/IP).

World-wide access

Since standard TCP/IP services from Windows are used, this data exchange can take place worldwide. The system offers scalable communication capacity and timeout periods for the monitoring of communications. OPC provides a standardized means for accessing many different SCADA packets. The SOAP (Simple Object Access Protocol) enables a connection between two computers to be established by means of an internet connection via standard HTTP. A TwinCAT component is available for this purpose.

Beckhoff Information System

Further information on the TwinCAT automation software can be found in the Beckhoff Information System.

The setup for installing the Beckhoff Information System is available to you on the Beckhoff *Products & Solutions* DVD and on our website for download.

In addition, the online version of the Beckhoff Information System can be found at https://infosys.beckhoff.com.

4.1 TwinCAT libraries

TwinCAT libraries

See software documentation in the Beckhoff Information System.

TwinCAT 2: TwinCAT PLC Lib: TcIoFunctions

TwinCAT 3: TwinCAT 3 PLC Lib: Tc2_IoFunctions

5 Appendix

5.1 Beckhoff Identification Code (BIC)

The Beckhoff Identification Code (BIC) is increasingly being applied to Beckhoff products to uniquely identify the product. The BIC is represented as a Data Matrix Code (DMC, code scheme ECC200), the content is based on the ANSI standard MH10.8.2-2016.

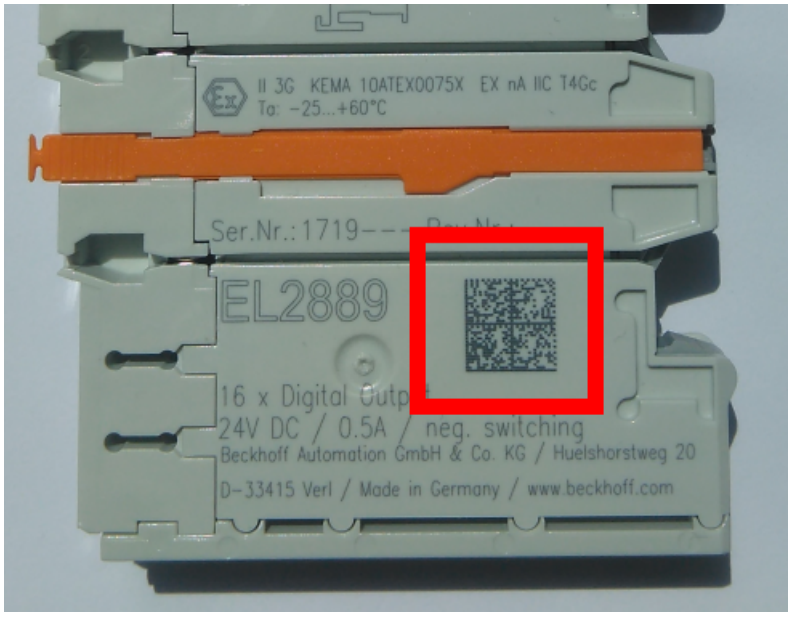


Fig. 38: BIC as data matrix code (DMC, code scheme ECC200)

The BIC will be introduced step by step across all product groups.

Depending on the product, it can be found in the following places:

- on the packaging unit
- directly on the product (if space suffices)
- on the packaging unit and the product

The BIC is machine-readable and contains information that can also be used by the customer for handling and product management.

Each piece of information can be uniquely identified using the so-called data identifier (ANSI MH10.8.2-2016). The data identifier is followed by a character string. Both together have a maximum length according to the table below. If the information is shorter, spaces are added to it.

Following information is possible, positions 1 to 4 are always present, the other according to need of production:

Position	Type of information	Explanation	Data identifier	Number of digits incl. data identifier	Example
1	Beckhoff order number	**Beckhoff order number**	1P	8	1P072222
2	Beckhoff Traceability Number (BTN)	**Unique serial number, see note below**	SBTN	12	SBTNk4p562d7
3	Article description	**Beckhoff article description, e.g. EL1008**	1K	32	1KEL1809
4	Quantity	**Quantity in packaging unit, e.g. 1, 10, etc.**	Q	6	Q1
5	Batch number	Optional: Year and week of production	2P	14	2P401503180016
6	ID/serial number	Optional: Present-day serial number system, e.g. with safety products	51S	12	51S678294
7	Variant number	Optional: Product variant number on the basis of standard products	30P	32	30PF971, 2*K183
...					

Further types of information and data identifiers are used by Beckhoff and serve internal processes.

Structure of the BIC

Example of composite information from positions 1 to 4 and with the above given example value on position 6. The data identifiers are highlighted in bold font:

1P072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

Accordingly as DMC:

Fig. 39: Example DMC **1P**072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, position 2). The BTN is a unique serial number consisting of eight characters that will replace all other serial number systems at Beckhoff in the long term (e.g. batch designations on IO components, previous serial number range for safety products, etc.). The BTN will also be introduced step by step, so it may happen that the BTN is not yet coded in the BIC.

NOTICE

This information has been carefully prepared. However, the procedure described is constantly being further developed. We reserve the right to revise and change procedures and documentation at any time and without prior notice. No claims for changes can be made from the information, illustrations and descriptions in this information.

5.2 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Support

The Beckhoff Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline:	+49 5246 963 157
e-mail:	support@beckhoff.com
web:	www.beckhoff.com/support

Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline:	+49 5246 963 460
e-mail:	service@beckhoff.com
web:	www.beckhoff.com/service

Headquarters Germany

Beckhoff Automation GmbH & Co. KG

Hülshorstweg 20
33415 Verl
Germany

Phone:	+49 5246 963 0
e-mail:	info@beckhoff.com
web:	www.beckhoff.com

Table of figures

More Information:
www.beckhoff.com/KL2xxx

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com